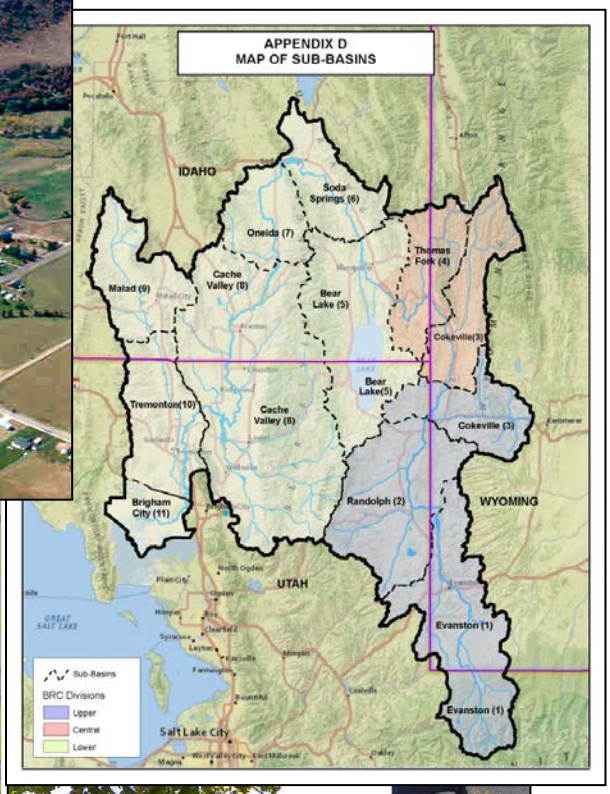
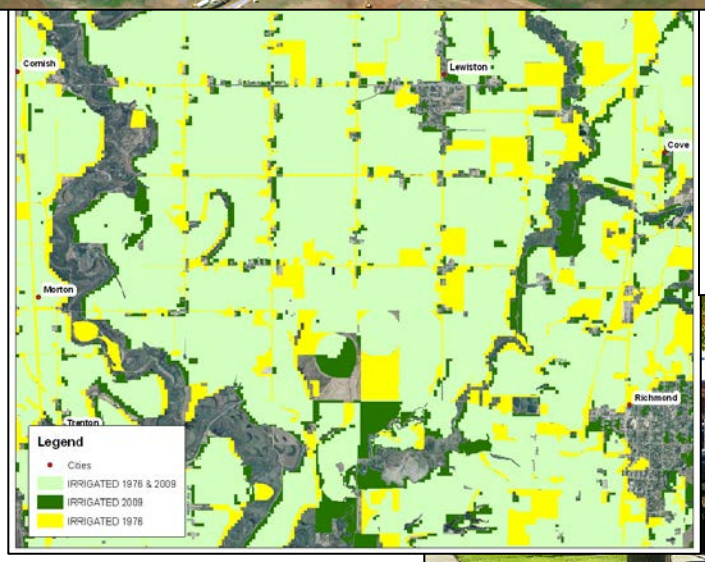
BEAR RIVER COMMISSION

2009 DEPLETIONS UPDATE





April 15, 2014

BEAR RIVER COMMISSION

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Technical Memorandum

TO: **Bear River Commission**

FROM: **Technical Advisory Committee**

SUBJECT: **2009 Depletions Update**

DATE: **February 25, 2014**

Summary

The Bear River Commission charged its Technical Advisory Committee (TAC) with updating its depletion estimates pursuant to the Amended Bear River Compact and Depletion Procedures. The last depletion estimates were accepted by the Commission in 1992 and were based on 1990 irrigation and water usage data. The TAC has now updated the depletion estimates through 2009 and submits its findings, methodologies and recommendations to the Commission. Figure 1 below shows a summary of the TAC's estimates of depletion amounts pursuant to the Amended Compact.

This update is based on a review of new acres irrigated and acres taken out of irrigation since January 1, 1976, both new full supply and supplemental supply, as well as an estimate of municipal and industrial uses (M&I) and reservoir evaporation. The three states' technical staff worked cooperatively on a methodology to update irrigated acreage maps and account for supplemental supply acres. Each state prepared its own, though similar, report on M&I usage and reservoir evaporation estimates. This update is based on the Commission's approved procedures for Water Depletion.

Issues encountered during the effort included: issues discovered in the original 1976 base maps; problems with comparing 1976 GIS coverages with 2009 coverages with much finer detail; concerns with depletion values and uncertainty with depletion rates for post-1976 supplemental acreage depletion values. At several stages through the effort, the TAC received feedback and direction from the Management Committee and the Commission. This memorandum preserves for the Commission the TAC's efforts, findings and recommendations for future depletion update efforts.

Bear River Commission

Estimated Annual Depletions[1]

Changes from January 1, 1976, to December 31, 2009

ABOVE STEWART DAM

State	Allocation	Agricultural Depletions	M&I Depletions	Reservoir Evaporation	Total Depletions	Remaining Allocation
Utah	13,000	5,935	-5	841	6,771	6,229
Wyoming	13,000	2,407	401	197	3,005	9,995
Idaho	2,000	1,310	3	0	1,313	687

LOWER DIVISION

State	Allocation	Agricultural Depletions	M&I Depletions	Reservoir Evaporation	Total Depletions	Remaining Allocation
Idaho	125,000[2]	8,667	300	11	8,978	116,022
Utah	275,000[3]	-5,771	5,978	0	207	274,793

[1]Any reductions in pre-1976 depletions are reflected in the above numbers.

[2]First right under Compact. Compact grants additional rights.

[3]Second right under Compact. Compact grants additional rights.

Figure 1. Summary table of depletion amounts.

Background

The amended Bear River Compact recognized water applied to beneficial use prior to January 1, 1976. The Compact allows for additional depletion amounts to Idaho and Utah in the Lower Division. Determination of the post-January 1, 1976, depletion usage is to be determined by a "Commission-approved procedure." The Compact also provides for additional storage above Stewart Dam and provides that the depletion associated with this storage, as well as post-January 1, 1976, surface and groundwater rights above Stewart Dam, should be determined also by a Commission-approved procedure. The Commission first made an estimate of depletion amounts pursuant to the Compact through 1990. Preceding this effort, the Commission had contracted with Utah State University, in cooperation with the University of Idaho and the University of Wyoming, to estimate irrigation depletion requirements for sub-basins within the Bear River system. That resulted in a report titled "Duty of Water Under the Bear River Compact: Field Verification of Empirical Methods for Estimating Depletion." Further, the Commission approved a three-state mapping project to determine irrigated acreage as of January 1, 1976. This effort, completed in 1992, resulted in base maps showing irrigated acreage throughout the Bear River Basin. Also pursuant to this effort, the Commission adopted procedures for determining depletion amounts. Then, pursuant to those procedures and the data obtained

as to depletion rates and irrigated acreages, each of the three states prepared an estimate of its depletion amounts. This effort included the following reports which were submitted to, and approved by, the Commission at its April 1992 annual meeting (copies of these reports are found within the Commission meeting minutes).

"Bear River Compact Base Mapping" (Idaho), April 1992 Commission Minutes, Appendix F.

"1976 Base Map Verification" (Utah), April 1992 Commission Minutes, Appendix G.

"Wyoming's Bear River Basin Base Mapping Project & Estimated Increased Depletions, January 1, 1976 through January 1, 1990," April 1992 Commission Minutes, Appendix H.

"Estimated Depletions (1976-1990) for the Utah Portion of the Bear River Basin as Defined by the Amended Bear River Compact," April 1992 Commission Minutes, Appendix I.

"Idaho – Estimation of New and Supplemental Irrigation Acreage since 1976 for the Bear River Compact," April 1992 Commission Minutes, Appendix J.

The Commission-approved procedures called for updating of the depletion efforts every five years in the Central Division of Idaho and every ten years elsewhere, or as determined by the Commission. This present effort is the Commission's first update of the depletion estimates since the 1990 depletion estimates.

Agricultural Depletions

Methodology

The depletion estimates were updated by multiplying the change in irrigated acreage by the depletion rate per full supply acre for each sub-basin. The depletion rate per acre is based on evapotranspiration rate estimates for local crops weighted by the crop mix for the sub-basin (see Appendix B of the Commission's Depletion Procedures). **In this depletion update effort, there was no change to the depletion rate**. In addition to the full supply acres, since 1976 a number of acres which were irrigated prior to 1976 have now received an additional supply or supplemental source. Each state, as described below, developed its own methodology, based on available data, to estimate the additional depletion associated with these supplemental acres.

The TAC had an extended discussion regarding the variability in irrigation from year to year. Considered were the options of tabulating the "actual" irrigation found in a given year versus the "permitted" irrigated acres. It was believed that the "actual" may underestimate the depletion as it may not include some fields which were generally irrigated but just not in the year that the survey was made. It was also believed that a tabulation of the "permitted" acres would overstate the depletions as some of these acres have not yet been developed. After review and input from the Commission, the TAC determined that the reported changes in irrigated acres should be tied to the "developed" irrigation rather that what was found in the specific year for which the data were tabulated or what was permitted. The definition of "developed" acres would include those acres

which had been developed under a full supply or supplemental water right since 1976 regardless of whether or not they were being irrigated during the review period, unless the water right had been moved off the acres or otherwise canceled.

Irrigated Acres (Full Supply)

Under the direction of the TAC, the GIS group, which consisted of GIS professionals from each BRC state, were tasked with determining the actual change of irrigated acreage (positive or negative) as compared to the 1976 GIS base maps that were adopted by the Commission. The following is a general description of the methods and procedures used commonly by each of the states. The discussion below, as well as Appendices A, B and C, contain information regarding more specific procedures for individual states.

The first step was to update the line work using more modern data sets. Using primarily 2009 aerial imagery from the National Agriculture Imagery Program (NAIP) as a backdrop, existing line work from various sources was overlaid and the line geometry was adjusted, added, or removed based on visual interpretation of the field boundaries in the imagery.

The next step involved comparing 1976 mapping with the current 2009 line work to determine which areas have new irrigation or areas that have gone out of production. Initial intersect and overlay GIS analyses of the original 1976 and the new 2009 data showed a very high rate of technical line work discrepancies and some errors between data sets. This resulted in output that summarized mostly the erroneous differences between data sets and not actual change in irrigated acreage. The errors between the data sets exist because each data set was derived from different bases at different scales and resolutions. For example, since the 1976 data was derived from coarse resolution 60-meter satellite data, a large polygon of irrigated acreage also included many roads, idle edges of fields, and other small urban features that were indistinguishable at 60-meter resolution. The 2009 data were derived from much higher resolution (1-meter) aerial photography which provided much greater clarity and detail when identifying and attributing roads, idle edges of fields, and small urban features. Therefore, a direct GIS comparison of the two data sets does not provide accurate or useful results. Consequently, the states opted to either merge or view the 1976 data into the new 2009 data set and manually review, section by section, to visually identify polygons in the 2009 line work that are actually new irrigated acreages or acreages that have gone out of production.

Comparison of the 1976 and 2009 data involved both automated GIS analyses tools and a manual interpretation process. The GIS analysis process was used as the automated comparison to automatically identify areas of change since 1976. This GIS analysis yielded both areas of actual change as well as differences in the data sets due to minor and major line work and classification discrepancies.

To clearly identify which differences in the data sets were actual changes in irrigated acreage, a manual review process was implemented section by section to visually

compare the 1976 classification with the 2009 classification using aerial photography and other ancillary data to determine which polygons were new irrigated acres (added) or removed irrigated acres (subtracted).

The output of this process was also evaluated from a water right point of view to determine if identified changes were supported with permitted water right information. In addition, areas classified in 1976 as irrigated cropland were evaluated to determine if new or additional water rights had been applied since 1976 and were, therefore, considered to be supplemental acreage, which is discussed in the Irrigated Acres (Supplemental Supply) section. Each state also conducted various levels of field verification. Actual fields were visited or experts in the regions were consulted.

The resultant data set for each state includes a land classification attribute with the following possible values: irrigated cropland, non-irrigated cropland, wetlands/naturally sub-irrigated pasture and hay, water, other, and urban. The resultant data set for each state also includes a change attribute to note areas of new irrigation (attributed as "added") and areas that went out of production (attributed as "subtracted"). In addition, a change attribute of "null" shows no change and a change type of "reclass" indicates discrepancies from the 1976 mapping, but no land type change actually occurred on the ground. As stated above, better technology just allowed more refined mapping. The net change in depletion totals due to new full and supplemental acres may be found in the Estimated Annual Depletions table above.

A brief explanation of the efforts performed by each state and issues encountered is given in the sections below. A more comprehensive review of each state's procedures can be found in Appendices A – C.

Idaho

Idaho followed the general methodology described above. Multiple sources of supporting imagery and datasets were available and used to update the line work and identify new irrigation. Land use classification was reviewed section by section using the available resources to confirm actual changes.

A water right search was conducted as supporting evidence for areas of added depletion. Field verification was completed during the spring of 2010 in targeted areas where imagery or water right review was inconclusive.

A more detailed report on Idaho's efforts to update the irrigated acres and changes since 1976 can be found in Appendix A.

Utah

The State of Utah also followed the general methodology as described. Multiple sources of supporting imagery and other data were available and used to update the line work and identify new irrigation or areas that went out of production. Land use classification was reviewed section by section using the available resources to

confirm actual changes. A water right search was conducted as supporting evidence for areas of added depletion which is described below.

A more detailed report on Utah's efforts to update the irrigated acres and changes since 1976 can be found in Appendix B.

Wyoming

Along with the general methodology described above, Wyoming also performed an additional step in the mapping process. Water right permits of record in the Bear River Basin were queried from the Wyoming State Engineer's Office water rights database. The permits resulting from that query included both groundwater and surface water permits. The associated permit maps were scanned and the images georeferenced into ArcMap. The irrigation associated with each permit was mapped to create an irrigated acreage layer, with each feature corresponding to a permit number. This layer was used as an additional reference for the mapping described above.

A more detailed report on Wyoming's efforts to update the irrigated acres and changes since 1976 can be found in Appendix C.

Irrigated Acres (Supplemental Supply)

The Commission-approved procedures also call for determination of additional depletion associated with supplemental supply to irrigated acres. The procedures identify two different categories of supplemental supplies, namely 1) project development, which would include things such as building of a reservoir or other project to provide supplemental water to an area, and 2) other development, which would be determined to be the smaller supplemental supplies generally for individual fields or farms. The procedures provide that for the project development, the states are to prepare a report identifying the amount of additional depletion associated with the project development. In this memo, under the Utah section, is found an evaluation of the following three projects: Woodruff Narrows, Woodruff Creek and Porcupine Reservoirs. Wyoming users also receive supplemental supply from the Woodruff Narrows Reservoir, Sulphur Creek and several other smaller reservoirs. In Idaho, two supplemental projects were identified, namely, Twin Lakes Canal Company's use of waters from Deep Creek and the Malad Valley Irrigating Company's development of Devil Creek.

All other supplemental water usage in the three states was found to fall under the "other development" category. The 1992 determination of depletion associated with the other development required the application of the depletion rates associated with a full water supply to be multiplied by a shortage rate for each sub-basin The shortage rates were based on a study performed in the 1970s identifying deficiencies in water supply to meet water requirements. For the 1992 depletion update, Idaho used a different shortage rate than the states of Utah and Wyoming.

Because the use of sub-basin shortage rates was called into question as a method for dealing with the additional depletion associated with individual supplemental water rights, for this depletion update effort it was determined by the Commission that the TAC should re-examine this previously used methodology. Upon review, it was determined that each state should try to determine on a case-by-case basis the supplemental depletion associated with supplemental acres which have been developed since 1976. As reported below, Idaho used power record data to estimate the amount of water used from supplemental sources. Utah estimated supplemental supply rates for individual water rights based on contacts with irrigators and review of "sole supply" values. Wyoming reviewed diversion records to determine the period of average supplemental usage each year and multiplied the number of days by the estimated daily crop consumptive values.

It should be noted that the supplemental supply accounting only applies to those acres which received a supplemental supply after 1976, but which were irrigated with an original supply prior to 1976. The reason for this is that if the original supply for the acres was based upon post-1976 development, the state would have already been charged for a full supply depletion for those acres and hence, charging for a supplemental supply in addition to the full supply would be overcharging the depletion amount.

Idaho

A 2009 water right review included water right licenses and permits with priorities from January 1, 1976, thru December 31, 2009, within the Idaho portion of the Bear River Basin. Information from each water right file was compared to the 1976 base maps and 2009 imagery to determine whether new or supplemental irrigation should be accounted for. Acres considered new irrigation from water right records were then compared to those acres GIS staff considered new irrigation from imagery review. Any acres not overlapping were then given a second review by GIS staff. Acres considered irrigated in 1976 and 2009, with a recorded pre-1976 priority water right and post-1976 priority water right, were counted as supplemental. Acres considered irrigated in 1976 and 2009, but having only a post-1976 water right, were considered a "getting legal" action and not counted. Acres covered by a post-1976 water right, but showing no irrigation or development, were not counted.

Idaho estimated supplemental irrigation depletion using estimates of groundwater pumping based on power consumption records from Utah Power for electric-driven pumps. Annual depletion was estimated by applying an efficiency factor for the irrigation system to the estimate of annual volume of water pumped.

The Power Consumption Coefficient (PCC) method estimates volume of water pumped based on a relationship between the power demand (KW) at the pump motor and the flow discharged from the pump to the irrigation system. Once the

PCC is determined for a specific system, the annual power usage (KWh) can be converted to annual volume pumped.

Power consumption records and other data for the 2003 to 2012 period were used to estimate PCC. Staff used water right records, County Taxlot (ownership) records, aerial imagery, and data from the Spatial Dynamics well inventory collected in 1999 to match power records with specific wells and determine irrigated acreage, type of irrigation system, pump horsepower, flow, overlapping water rights, and number of wells/pumps per system.

After gathering the data, staff calculated a PCC, determined the annual volume pumped, and applied an efficiency factor to determine annual depletion. The efficiency for each system was estimated based on published values for sprinkler irrigation systems. Results were not calculated for every supplemental system due to a variety of reasons. Many of the wells could not be matched to power records, some systems were diesel or gas powered, and many systems included multiple wells or water rights.

A weighted average of depletion per supplemental acre was calculated based on the total depletion and acreage irrigated under the supplemental rights. This only included those determined to be supplemental for the purposes of calculating a representative supplemental depletion per acre. Results of the depletion estimates are 0.59 acre-feet per acre in the Central Division and 0.69 acre-feet per acre in the Lower Division in Idaho. The resultant depletion estimates were applied to the total number of acres previously identified as supplemental from the land classification effort. This included the acreage for those systems that converted a post-1976 supplemental water right to primary use on lands identified as irrigated prior to 1976.

A more detailed report on Idaho's efforts to estimate depletion from supplemental irrigation since 1976 can be found in Appendix A.

Two water right permits associated with existing irrigation projects were identified in the Lower Division. The first permit is held by the Twin Lakes Canal Company to divert water from Deep Creek into Twin Lakes Reservoir. The permit authorizes 4,040 acre-feet to be diverted to storage during the non-irrigation season to be used for irrigation within the canal company service area. The permit did not authorize additional capacity for the reservoir nor additional acres within the service area. Historic records available at the Department of Water Resources regarding operation of the reservoir are limited, but suggest that the reservoir has filled annually prior to approval of the permit. Consultation with canal company officials confirmed that the permit has seen very limited use in the past due to pumping costs and availability of water, so it is best characterized as an alternate source rather than a supplemental supply of water. Consequently, no new depletion is associated with the permit. Canal company officials also said that the company is interested in finding ways to further develop the use of water under the permit. It is

recommended that the permit status be reviewed as part of future depletion estimates to evaluate if diversions from Deep Creek provide a supplemental supply of water within the service area.

The second permit is held by the Malad Valley Irrigating Company to divert water from Devil Creek into Devil Creek Reservoir. The permit authorizes 700 acre-feet to be diverted to storage during the non-irrigation season to be used for irrigation within the canal company service area. The permit did not authorize additional capacity for the reservoir nor additional acres within the service area. The permit currently provides an alternate storage location for two other reservoirs owned by Malad Valley Irrigating Company that have storage restrictions due to dam safety concerns. Because the permit provides an alternate storage location for pre-1976 storage rights, no new depletion is associated with the permit. The permit required that proof of beneficial use be submitted in May 2013. It is recommended that the permit status be reviewed as part of future depletion estimates to evaluate if the storage situation changes such that diversions from Devil Creek under the permit provide a supplemental supply of water within the service area.

Utah

Supplemental water rights for the BRC 2009 irrigated acreage were determined in a two-part process. 1) A search was run on the Utah Division of Water Rights' database. All water rights with a filing date after 1976 were selected and reviewed by division staff. 2) Using GIS, the place of use for each water right was compared to the 1976 BRC mapping to determine if it needed to be classified as a new or supplemental right. A water right with a post-1976 priority date and covered under 1976 BRC mapping was classified as supplemental. If acreage was not covered by BRC mapping, then the right was classified as new. Project supplemental rights were evaluated as well as supplemental supplies for individual water rights.

For project calculations, an updated Woodruff Narrows Reservoir Model Simulation was run for the period 1941-2012 by the Utah Division of Water Resources. It is titled, "Woodruff Narrows Reservoir Simulation Results, February 2013," and is included in Appendix B of this report. The total increased depletion from the Woodruff Narrows Reservoir enlargement is 7,148 acre-feet. This is compared to 5,875 acre-feet in the 1992 report. The total is split between Utah (83%) and Wyoming (17%). The total increased depletion of 7,148 acre-feet includes 1,013 acre-feet of increased evaporation and 6,135 acre-feet of increased depletion associated with the supplemental irrigation of lands.

From the updated simulation, the total depletion for Utah (83%) is 5,933 acre-feet. Of that, 841 acre-feet would be attributed directly to Woodruff Narrows Reservoir evaporation and the remaining 5,092 acre-feet attributed to supplemental usage.

Woodruff Creek Reservoir has not been enlarged and, therefore, no additional depletion is associated with their post-1976 filing. The Porcupine Reservoir

enlargement amounted to an additional 396 acre-feet; therefore, the maximum depletion associated with their new supplemental water right would be 396 acre-feet.

Utah estimated supplemental supply rates for individual water rights based on contacts with irrigators and review of "sole supply" values. Sole supply acres are defined or limited either at the time of filing, indicating a shortage in the original supply to be made up by the supplemental filing, or at the time of certification of the supplemental filing, based on actual usage. In either case they are based on input from the irrigator. Supply depletion factors are either the sole supply acres percentage of the whole acres or estimates from irrigators contacted. Rather than use a sub-basin shortage rate for supplemental acres, as was used in the 1992 determination of depletion, a "supply" rate was determined on a case-by-case basis at the field level as reported and shown in Appendix B. The sole supply depletion value was calculated by multiplying acres by the depletion rate times the supply depletion factor. As was expected, this method revealed depletions 3 to 5 times greater than those that would be reported using the 1992 sub-basin shortage rates.

Wyoming

Wyoming reviewed its supplemental and additional supplies to find an average amount of supplemental use in the Bear River Basin within Wyoming. Supplemental supply in Wyoming is defined as another water supply from a separate surface water source which supplements the original irrigation water supply. Additional supply in Wyoming is defined as an additional water supply from a separate groundwater source which supplements the original irrigation water supply. Hereafter, the term supplemental supply will be used to refer to both supplemental supply and additional supply.

There are 4,673 post -1976 permitted supplemental acres. The supplemental water rights associated with 2,381 of these acres either have never been developed or have not used any water during the past ten years. The remaining 2,292 acres have developed a supplemental supply. This is the acreage used in the referenced calculations.

A water rights review of the paper records was conducted first. A spreadsheet was created listing all of the post-1976 irrigation permits granted with a supplemental supply or an additional supply. Diversion records for the years 2003-2012 were reviewed and each water right was field inspected in 2013 to verify sources and use of the supplemental supplies. The Hydrographer/Water Commissioners' and supervisor's personal knowledge, along with some questioning of the appropriator, helped to verify calculated days of use (supplemental supply days) for each supplemental right. The supplemental supply days is defined as the average number of days over ten years that the original supply water right was unavailable (for supplemental groundwater rights) or that the supplemental supply was actually used (for supplemental surface water rights).

Using information and methodologies from the *Field Verification of Empirical Methods for Estimating Depletions* by Robert W. Hill, et al, 1989, Penman-Monteith reference ET-calculated-values from the Randolph and Montpelier weather stations were used to develop a depletion factor for an August alfalfa crop near Cokeville. This depletion factor was determined to be 0.017 acre-feet per acre per day. The method used shows potential ET (where water is not limiting) based on the Penman-Monteith equation as presented in the above-referenced Hill report. This depletion factor was then multiplied by the number of days supplemental supply was used and the acreage irrigated. Using this method, the total depletion is 231.01 acre-feet. This number is reflected in the technical memorandum (the spreadsheet showing the calculations is included in Appendix C).

The following depletion amounts were calculated for delivery of reservoir water to irrigated lands and accounted for in the supplemental irrigation depletions:

Woodruff Narrows Reservoir – 1,043 acre-feet. This number is derived from the updated computer run performed by the UT DNR, simulating the amount of shortage and corresponding depletion difference between the original and enlarged Woodruff Narrows Reservoir under normal operating conditions for the 1941-2012 period (see Appendix B). The total depletion amount for this reservoir is 6,135 acre-feet, of which 17% or 1,043 acre-feet is allocated to Wyoming's depletions. Woodruff Narrows Reservoir is located in the Evanston sub-basin.

Sulphur Creek Reservoir – 0.00 acre-feet. No depletion was taken on this facility because the average total storage used, less the original compact storage allocated to this facility in combination with the unbuilt compact storage that can be transferred to this facility, never exceeded 4,100 acre-feet. Wyoming has a remaining unbuilt, original compact storage allocation of 4,100 acre-feet.

Heber/Broadbent Reservoir – 0.00 acre-feet. This facility receives both Bear River water and Green River water. No depletion was taken on this facility because the average amount of Green River water imported into the Bear River Basin for this facility is greater than the average capacity used by this facility and the Ben Reservoir combined.

Ben Reservoir – 0.00 acre-feet. This facility receives both Bear River water and Green River water. No depletion was taken on this facility because the average amount of Green River water imported into the Bear River Basin for this facility is greater than the average capacity used by this facility and the Heber/Broadbent Reservoir combined.

Coy Reservoir – 7.28 acre-feet. To calculate the depletion amount, the reservoir surface evaporation loss amount (12.35 acre-feet, see Reservoir Evaporation section) was subtracted from the amended compact storage amount (26.90 acre-feet). This resulted in 14.55 acre-feet. It was assumed that half of that amount

would be delivered to lands and, assuming a 50% efficiency rate, resulted in a total depletion of 7.28 acre-feet. Coy Reservoir is located in the Evanston sub-basin on Yellow Creek.

The total of depletion taken for the above mentioned reservoirs is 1,050.28 acre-feet. Therefore, the total depletion amount for supplemental irrigation to individual projects and supplemental irrigation from reservoir storage is 1,281.28 acre-feet (1,050.28 acre-feet of depletion associated with reservoir delivery plus 231 acre-feet of depletion associated with supplemental irrigation for individual projects).

Depletion Rates

As was indicated above, in 1982 the Commission hired university staff in the three states to complete an analysis of depletion rates based on the then crop mixes in the various sub-basins within the Bear River Basin. That culminated in a 1989 report which has been specifically referenced in the Commission's approved procedures. As part of this depletion update effort, the TAC reviewed potential options which could be employed to update the depletion rates. Such options included incorporating data recently developed by Utah State University as part of a crop requirement study completed for the State of Utah, as well as looking at updating the crop mix within each of the sub-basins. However, after review of the options, the TAC determined that, at this juncture in time, it would recommend continuing to use the depletion rates developed for, and included within, the Commission's approved procedures. This decision was principally reached due to the fact that there is no consensus as to appropriate updated values and because the Utah State University changes are probably within the error of the estimates. Therefore, the depletion rates used for this update are the same rates found in Appendix B of the Commission's 1993 approved procedures.

In reviewing the GIS coverages, it was found that the sub-basin boundaries to which depletion rates have been estimated did not exactly match in all instances the current hydrologic unit boundaries and, therefore, a new sub-boundary map has been developed and adopted by the three states as part of this effort (see Appendix D).

Estimate of Irrigation Depletion

Based on the above-described methodology, each state determined the number of full supply and supplemental supply acres irrigated within each sub-basin. These acres are found in the table below (Figure 2). The columns shown as "Irrig." represent acres developed since 1976 and receiving a full irrigation supply, whereas the columns shown as "Suppl. Irrig." represent acres which were irrigated prior to 1976, but which received an additional or supplemental water supply after 1976.

Bear River Commission
Depletions Update
Net Change in Irrigated Acres: 1976 to 2009

	Idaho		Utah		Wyoming	
	Irrig.	Supp. Irrig.	Irrig.	Supp. Irrig.	Irrig.	Supp. Irrig.
Sub-basin	(ac)	(ac)	(ac)	(ac)	(ac)	(ac)
Above Stewart Dam						
1 – Evanston			0	32	-655	25
2 – Randolph			390	951	0	0
3 – Cokeville	0	0	31	0	1,683	2267
4 – Thomas Fork	511	739			55	0
5 – Bear Lake	340	0				
Subtotal	**851**	**739**	**421**	**983**	**1,083**	**2,292**
Lower Division						
5 – Bear Lake	198	315	-319	550		
6 – Soda	309	178				
7 – Oneida	118	1,224				
8 – Cache Valley	281	2,420	-7,037	9,307		
9 – Malad	838	4,400				
10 – Tremonton	559	387	-950	1,378		
11 – Brigham City			-249	810		
Subtotal	**2,303**	**8,924**	**-8,555**	**12,044**		

Figure 2. Table of full and supplemental supply acres.

The full supply acres were then multiplied by the corresponding depletion rates from Appendix B of the Procedures to estimate the depletion. As was described above, each state employed a different method for estimating the depletion associated with the supplemental acres shown below. In addition, specific estimates were made for supplemental projects.

Bear River Commission
Depletions Update
Net Change in Irrigation Depletion: 1976 to 2009

	Idaho			Utah			Wyoming		
	Full	Supplemental		Full	Supplemental		Full	Supplemental	
	Irrig.	Projects	Individual	Irrig.	Projects	Individual	Irrig.	Projects	Individual
Sub-basin	(af)	(af)	(af)	(af)	(af)	(af)	(af)	(af)	(af)
Above Stewart Dam									
1 - Evanston				0	0	0	-681	1,050	40
2 - Randolph				468	5,092	343	0	0	0
3 - Cokeville	0	0	0	32	0	0	1,750	0	191
4 - Thomas Fork	531	0	436				57	0	0
5 - Bear Lake	343	0	0						
Subtotal	**874**	**0**	**436**	**500**	**5,092**	**343**	**1,126**	**1,050**	**231**
Lower Division									
5 - Bear Lake	200	0	217	-322	0	85			
6 - Soda	312	0	123						
7 - Oneida	118	0	845						
8 - Cache Valley	281	0	1,670	-7,037	396	1,952			
9 - Malad	989	0	3,036						
10 - Tremonton	609	0	267	-1,036	0	318			
11 - Brigham City				-289	0	361			
Subtotal	**2,509**	**0**	**6,158**	**-8,684**	**396**	**2,717**			

Figure 3. Summary of Irrigation Depletion Estimates

The following is an explanation by state as to unique circumstances regarding the calculation of the above-estimated depletion amounts.

Idaho

During Idaho's review, irrigated lands were identified with a source of surface water originating from an adjacent compact division or from groundwater that is not tributary to the Bear River. The map inserted below shows two irrigated areas located outside the established compact division boundary from which water is diverted. No new or supplemental irrigation was identified in either of the two areas.

The area northwest of Grace is located outside the Bear River hydrologic boundary, but those lands are irrigated by surface water originating from the Bear River or tributaries in the Lower Division. The lands are irrigated by Last Chance Canal and Farmers Land and Irrigation Corp. Last Chance Canal diverts water from the Bear River. Farmers Land and Irrigation Corp. divert water from Big Spring Creek and Soda Creek, which are both tributaries to the Bear River.

The area mostly west of Stewart Dam designates lands located outside the Central Division, but those lands are irrigated by surface water originating from the Bear River in the Central Division. Note that the extent of that area was changed since the 1992 report because it previously included the Montpelier Irrigation Co. service area, but the company diverts water from Montpelier Creek which is tributary to the Bear River in the Lower Division. Other minor changes since 1992 were due to better water right data and use of GIS tools to more clearly define the water right places of use.

Two half pivots located west of Soda Springs, just south of the highway, were found to be new irrigation since 1976. Water right review confirmed the source to be groundwater. According to a paper published by the Idaho Geological Survey (Martin, M., Wylie, A., Otto, B. *Hydrogeologic Analysis of the Water Supply for Bancroft, Caribou County, Idaho*. Idaho Geological Survey, Information Circular 61, 2005), the groundwater divide between the Portneuf and the Bear River Basins is south of the pivots. Those acres were not counted as new depletion because the source is not from the Bear River Basin.

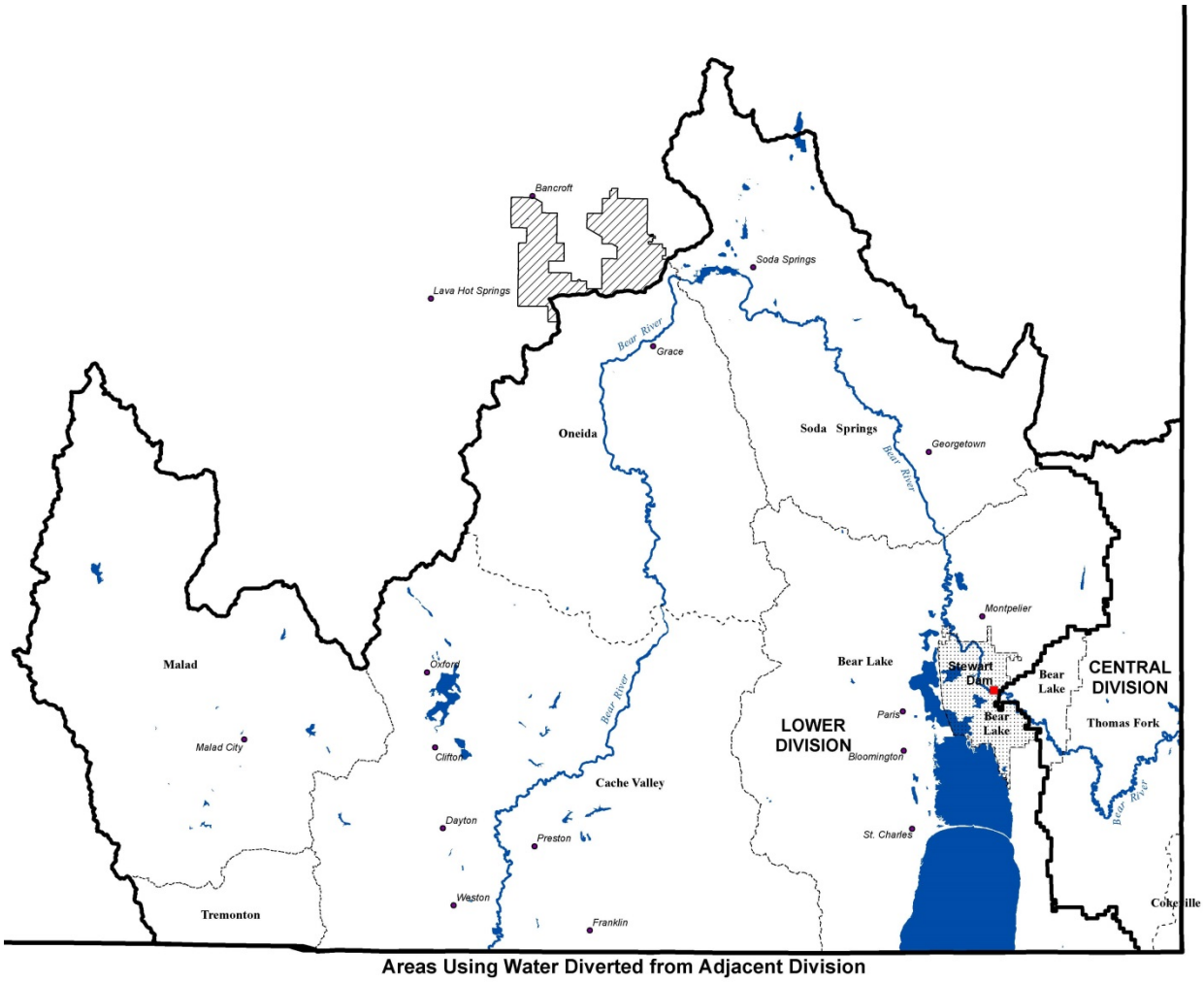

Figure 4. Map showing areas using water diverted from adjacent division

Utah

Depletion estimates for new acres that are considered "full supply" were determined using depletion rates found in Appendix B of the Procedures for the Evanston, Randolph, Bear Lake, Cache Valley, Tremonton and Brigham City sub-basins in Utah.

Wyoming

Depletion amounts for Wyoming were determined using the depletion rates found in Appendix B of the Procedures for the Evanston, Randolph, Cokeville and Thomas Fork sub-basins.

Municipal and Industrial Depletions

The states discussed available data and appropriate methodologies to determine post-January 1, 1976, increases in municipal and industrial depletions. Idaho, Utah and Wyoming principally used change in population information to determine municipal depletions, using per capita rates that are consistent with the 1990 estimates. Idaho and Wyoming used water right data to determine industrial usage, whereas Utah used reported self-supplied industrial usage values. Detail as to methodology and findings relative to M&I usage is contained within the three state sections below.

Idaho

Municipal Depletions

Depletion of water for municipal uses was estimated based on data and procedures used in the Utah Division of Water Resources report of June, 1991 (*Municipal and Industrial Depletion Analyses for the Utah Portion of the Bear River Drainage Basin 1976-90*). A depletion estimate of 66 gallons/day/capita or 0.074 acre-feet/year/capita was used for the Idaho portion of the Basin. This is the same estimate that was used in Idaho's 1992 report to the Bear River Commission. This population-based estimate was used because measured or metered data are not available for many of the small communities in the Basin.

Population data for the estimates were obtained from the 2010 U.S. Census. The only adjustment made to the county totals was for Caribou County, where Bancroft (outside the Basin) population was subtracted from the county total. No adjustment was made for Oneida County which has a substantial land area not in the Basin. The data are as follows:

	1976	2010	Net Change
Bear Lake	6,800	5,986	-814
Caribou	7,632	6,586	-1,046
Franklin	8,300	12,786	+4,486
Oneida	3,300	4,286	+ 986
TOTALS	26,032	29,644	+3,612

The net population increase of 3,612 results in a net increase in depletion of 267 acre-feet per year in the Basin. A water right search was completed and confirmed that there are no municipal or large domestic water rights in the Central Division in Idaho. All the municipal depletion was assumed to be in the Lower Division.

Industrial Depletion

A water right search was completed to identify industrial or commercial uses in the Idaho portion of the Basin. Only 3 water rights were identified with development in

1976 or later (based on the date licensed, examined or proof of beneficial use submitted). The water rights are summarized below.

Water right 13-7220 is a licensed groundwater right in the name of Toone Dairy Farm Inc. with a priority date of October 14, 1977. The right authorizes commercial, domestic and stock water uses for a dairy farm in the amount of 0.07 cfs. Water use for the stock water and commercial portions is limited to a volume of 11 acre-feet per year. Water used for stock water and commercial purposes is considered fully consumed. The point of diversion for the right is located in T11S, R40E Sec. 1, SWNE (Lower Division).

Water right 11-7262 is a licensed groundwater right in the name of Parson Ready Mix with a priority date of May 21, 1981. The right authorizes industrial use for a cement mixing plant in the amount of 0.25 cfs. Water use for the plant is limited to a volume of 2.9 acre-feet per year. The water use is assumed to be fully consumed. The point of diversion for the right is located in T13S, R44E Sec. 35, Lot 7, NESE (Central Division).

Water right 11-7438 is a licensed groundwater right in the name of J.R. Simplot Co. with a priority date of December 16, 1981. The right authorizes industrial use for a phosphate processing plant in the amount of 2.80 cfs. Water use for the facility is limited to a volume of 21.5 acre-feet per year. The water is used for a slurry with the phosphate and is transported out of the Basin, so the use is assumed to be fully consumed. The point of diversion for the right is located in T8S, R42E Sec. 16, Lot 7, SWNE (Lower Division).

Utah

Municipal Depletions

Depletion of water for municipal uses was estimated based on data and procedures used in the Utah Division of Water Resources report of June, 1991 (*Municipal and Industrial Depletion Analyses for the Utah Portion of the Bear River Drainage Basin 1976-90*). A population-based depletion estimate was obtained for each municipality or community supplied system by county in each Division, based on the 1992 state report to the Bear River Commission and follows the methodology in the Commission Approved Procedures. This estimate was then multiplied by the change in population estimates obtained from the 2010 U.S. Census.

Industrial Depletion

The depletion estimate for Industrial use was estimated based on 2010 water use data collected by the Utah Division of Water Rights for self-supplied industries. Consumptive use factors from the 1992 state report to the Bear River Commission were applied to the Commission Approved Procedures for each self-supplied water user. Total containment, self-supplied industry diversions are considered completely (100%) depleted.

Figure 5 titled "Summary of Depletions for Municipal and Industrial (M&I) Use in Utah" summarizes the 2010 depletions that are estimated for Utah.

Summary of Change in Depletion for Municipal and Industrial (M&I) Use in Utah

	1976	1990			2010	1976 -2010	
	Population	Population	Depletion (af)	per capita depletion (af)	Population	Change in population	Change in Depletion (af)
Upper Division							
Summit County							
Municipalities	0	0	0		0	0	0
Industrial							0
Rich County							
Municipalities	797	682	87	0.128	760	-37	-5
Industrial							0
Division Total							-5
Lower Division							
Rich County							
Garden City	1,648	2,730	121	0.044	3,729	2,081	92
Other municipalities	286	314	25	0.080	330	44	4
Industrial							0
Cache County							
Municipalities	48,402	65,730	3,278	0.050	107,330	58,928	2,939
Industrial							83
Box Elder County							
Municipalities	10,712	13,950	995	0.071	47,940	37,228	2,655
Industrial							205
Division Total	61,048	82,724				98,281	5,978

Notes

1976 and 1990 population and depletion are from 1992 report.

1990 per capita depletion is the 1990 depletion estimate divided by the 1990 population.

1976-2010 Change in Depletion is the change in population multiplied by the 1990 per capita depletion.

1976-2010 Change in Depletion for Industrial Use is from the table in Appendix B

Figure 5. Table summarizing Utah's M&I depletion estimates.

Wyoming

Municipal Depletions

There are three municipalities in the Bear River Basin in Wyoming: Evanston, Cokeville, and the Town of Bear River, incorporated in June of 2001. The City of Evanston's water supply treatment plant and sewage treatment plants allow the City to collect accurate water diversion, storage, use, and discharge data. Data were obtained from Brian Honey, Evanston City Engineer, and a depletion estimate of 73 gallons/capita/day or 0.0817 acre-feet/year was used. This is the same estimate used in Wyoming's April 1992 report to the Bear River Commission. No specific water supply data were available for Cokeville or the Town of Bear River, so it was assumed that their per capita consumptive use would be similar to that for Evanston.

For the 1976 estimate, population data for Evanston and Cokeville were obtained from the Wyoming Department of Administration and Information, Division of Research and Statistics. For the 2010 estimate, population data for the three municipalities were obtained from the 2010 census. The data are as follows:

	1976	2010	Net Change
Evanston	4,751	12,359	+7,608
Cokeville	539	535	-4
Town of Bear River	0	518	+518
TOTALS	5,290	13,412	+8,122

The net population increase of 8,122 results in a net increase of 663.57 acre-feet.

Industrial Depletions

The only significant industrial water user in the Basin is Chevron's Carter Creek Gas Plant. In the 1992 report to the Bear River Commission, Wyoming also reported use for Amoco's Whitney Canyon Gas Plant. In 2007, Amoco closed this plant.

In the 1990 update, Wyoming reported use for the Chevron Carter Creek Plant at 38 acre-feet. For this update, a computer run of the Woodruff Narrows Reservoir uses was performed by the Utah Division of Water Resources. The depletion associated with this plant is now accounted for in that updated model estimate.

The Union Pacific Railroad maintains some employee housing in the upper Bear River Basin and has a groundwater permit for this use. An allocation of 4 acre-feet per year was given to this water right and is listed in the table below under Altamont – UPRR housing.

Industrial parks are supplied by the City of Evanston; however, there are other businesses outside of the industrial parks. These businesses are supplied by groundwater and include use for welding shops, truck maintenance shops, etc. The

uses include water for shop and office use and potable water. An estimated depletion of 15 acre-feet per year was allocated to these miscellaneous businesses in the Evanston area and listed under Other in the table below.

For a summary of Wyoming's industrial depletions, please see the following table:

	USE IN AF (1976)	USE IN AF (2010)
Chevron Carter Creek Plant	38.00	0.00*
Whitney Canyon Gas Plant	225.00	0.00
Altamont – UPRR housing	4.00	4.00
Other	15.00	15.00
TOTAL	282.00	27.81

* This use is accounted for in the updated model of Woodruff Narrows Reservoir depletions.

The above table shows a decrease in Wyoming's industrial depletion of 263 acre-feet per year.

Reservoir Evaporation

It is recognized that in granting the additional depletion allocations under the Compact, both above and below Stewart Dam, often the construction of reservoirs would be required for storage of off-season water for later release, use and depletion. The TAC recognizes that such reservoirs, whether constructed for the purpose of providing irrigation, municipal or industrial waters, will evaporate water off of their surfaces. Therefore, separate and in addition to a depletion associated with usage of the waters described above, a calculation needs to be made for the depletion associated with the reservoir evaporation. Hence, in the section below, each state has identified reservoirs constructed both above and below Stewart Dam pursuant to these provisions of the Compact and the estimated depletion associated therewith. In some instances the additional depletion allocation was used to expand or enlarge existing reservoirs. In these instances the TAC determined that the appropriate depletion allocation should be based on the estimated increased surface area and, therefore, evaporative depletion associated with the enlargement. The depletion amounts reported below by each state are in addition to the depletion amounts calculated in the above sections which are associated with the use of such waters.

Idaho

A water right search for post-January 1, 1976, irrigation, municipal or industrial storage uses identified a single small reservoir to be counted as a new depletion due to evaporation from the reservoir. Water right license No. 13-7277 authorizes storage of 12.1 acre-feet of water for irrigation use with a source from Oxford Slough Creek within the Cache Valley sub-basin in the Lower Division. The reservoir is approximately 4 acres in surface area. Using an evaporation rate of 2.62 acre-feet/acre-year for shallow

ponds from the Preston weather station (http://data.kimberly.uidaho.edu/ETIdaho/), the depletion due to evaporation is estimated to be 10.5 acre-feet per year.

Utah

Woodruff Creek – A water right was approved for reservoir enlargement of 5,400 acre-feet, but the project has not been built, so there is no increase in reservoir surface area.

Porcupine – The Dam was structurally upgraded in 2001. In doing so, the storage capacity was increased from approximately 12,800 acre-feet to 13,196 acre-feet with no appreciable increase in reservoir surface area. The maximum depletion was accounted for under the new supplemental water right such that no additional depletion need be taken for reservoir evaporation.

Woodruff Narrows Reservoir – 841 acre-feet. This number is derived from the updated computer run performed by the UT DNR. The total reservoir evaporation from this reservoir is 1,013 acre-feet, of which 83% or 841 acre-feet is allocated to Utah's depletions.

Wyoming

The following are evaporation amounts taken for three Wyoming reservoirs, listed below:

Woodruff Narrows Reservoir – 172 acre-feet. This number is derived from the updated computer run performed by the UT DNR. The total reservoir evaporation from this reservoir is 1,013 acre-feet, of which 17% or 172 acre-feet is allocated to Wyoming's depletions.

Sulphur Creek Reservoir – 0.00 acre-feet. No depletion for reservoir evaporation was taken on this facility because the average total storage used, less the original compact storage allocated to this facility, in combination with the un-built compact storage that can be transferred to this facility, never exceeded 4,100 acre-feet.

Heber/Broadbent Reservoir – 0.00 acre-feet. This facility receives both Bear River water and Green River water. No depletion for reservoir evaporation was taken on this facility because the average amount of Green River water imported into the Bear River Basin for this facility is greater than the average capacity used from this facility and the Ben Reservoir combined.

Ben Reservoir – 0.00 acre-feet. This facility receives both Bear River water and Green River water. No depletion for reservoir evaporation was taken on this facility because the average amount of Green River water imported into the Bear River Basin for this facility is greater than the average capacity used of this facility and the Heber/Broadbent Reservoir combined.

Coy Reservoir – 12.35 acre-feet. This facility is allocated 26.90 acre-feet of amended compact storage. To calculate evaporation on this facility, the surface area closest to the amended compact storage capacity was used. That number was then multiplied by 1.42 (the number, in feet, of evaporative loss for the area in which the reservoir is located).

Bonneville Reservoir – 12.22 acre-feet. This number was calculated using the average surface area of the active capacity of the reservoir. That number was then multiplied by 2 (the number, in feet, of evaporative loss for the area in which the reservoir is located).

The total depletion amount for reservoir evaporation for Wyoming reservoirs is 196.57 acre-feet.

Preservation of Data

In order to ensure that the final products from the 2009 depletions effort are not lost or otherwise deteriorate, each state and the BRC office will have in their possession a duplicate copy of the final GIS "geo-database" data files and supporting documentation on CDs. The data can also reside in data centers in each state. The CDs will also contain ancillary documents associated with the depletions update effort, including this memorandum and tables used by the states to tabulate things such as supplemental acres. Maps will also be generated of the 2009 data just as was done for previous data sets. Electronic versions of these maps will be distributed to each state in pdf format. Hard copy versions of these maps will also be located at the BRC business office.

Recommendations on Future Updates

Based on the efforts performed and the experience gained in making this depletions update, the following are recommendations for future depletion updates.

- In initiating the effort, it was difficult for the states to confirm the starting point based on preservation of prior irrigation mapping efforts. As part of this effort, the state GIS experts have created a common "geo-database" file into which all three states' data have been placed. It is recommended that this file be distributed to each of the three states, as well as the Commission, such that each entity has a copy of all the data which can be used as a beginning point in future update efforts.

- Significant time was expended by the states in trying to compare prior GIS data derived from older GIS technology with present technology. It was initially hoped that using software, comparisons could be simply made between the 1976 and the 2009 data sets to determine real differences in irrigated acreage. However, significant issues were encountered, principally in the areas of 1) potential errors in the original 1976 data set, and 2) differences in resolution (scale detail) between the two data sets. To resolve these issues, significant hours were expended doing a manual process, visually going field by field through the Basin and comparing 1976 GIS data with 1976 satellite images and 2009 aerial photos to determine true

differences. With this effort now complete, it is recommended that future updates use the 2009 GIS data as the starting point to compare future years against (which includes refined 1976 delineation) - rather than referring back to the old 1976 base maps which would then incur the same significant efforts in resolving errors discussed in the effort just completed.

- Compile a CD of "final" GIS data and other supporting electronic documents and data (i.e., massaged 1976 data that was used for ag. analysis, final calculation spreadsheets, or other final documentation) and distribute to each state and BRC business office.

- Have the state GIS staff create a specific schedule for updating software and data formats. Have the state GIS staff review software updates and data preservation, including data format version compatibility prior to the April 2015 Commission meeting and every two years thereafter. After making such updates, redistribute updated materials to each of the states and the Commission.

- Estimating the increased depletion associated with supplemental water rights proved difficult. There was not a common dataset to distinguish supplemental irrigation and provide for the use of a common methodology amongst the states. The TAC should consider the development of a common methodology for post-1976 supplemental water right depletion amounts rather than the individual methods described for this effort. Upon determining a methodology, the states should then collect needed data until the next depletions update.

- The ET values used in developing the depletion rates are based on the 1989 report titled *Duty of Water Under the Bear River Compact: Field Verification of Empirical Methods for Estimating Depletion*, Research Report 125, Utah Agricultural Experiment Station, Utah State University. The TAC should review options for updating ET rates and determine potential costs and benefits for updating these values before the next depletions update.
    - Among other options the TAC should consider the use of state-of-the-art methodologies such as METRIC.
    - Depending on the methodology used, the crop mix should be reviewed within the sub-basins.

- The municipal depletions values used by all three states are based on per capita depletion estimates made by the Utah Division of Water Resources in 1990. The TAC should review and update water usage and municipal depletion values and determine whether or not better values are available for future depletion updates. The TAC should consider the development of a common methodology and/or per capita depletion rate.

- There are relatively few post-1976 industrial water rights within the Bear River Basin. However, the TAC should review methods used to estimate depletions from industrial rights and seek for a common approach.

- Efforts should continue to better define water rights and increase data collection for water rights in the Bear River Basin to meet the identified depletion methods and data needs.

- After considering the above, the TAC should create a timeline for review of specific depletion components.

Appendix A | Idaho Mapping Detail

Idaho Portion Bear River Compact

Internal Report

Margie Wilkins, Michael Verdun, and Nick Van Dyke

4/12/2012

IDWR internal report of Idaho's landuse classification procedures for the Bear River Basin in Idaho.

INTRODUCTION

This preliminary report describes the methodology used to produce the Idaho portion of the 2009 Bear River Basin landuse map classification. It lists the datasets used for compiling the landuse classification as well as the various techniques used in photointerpretation, GIS analysis, and field verification.

DATASETS

VECTOR datasets

Common Land Unit (CLU) polygons of individual fields digitized by the Farm Service Agency (FSA) in 2005 were used as a starting point in line work edits. Because of the Food, Conservation, and Energy Act of 2008 (FCEA), FSA no longer allows public access to the geospatial CLU polygon dataset and their associated land cover codes. IDWR, however, used an unattributed 2005 CLU polygon dataset obtained prior to the restrictions currently in place. The 2005 CLU polygons were used because they are an existing, relatively recent, highly detailed, vector dataset that could easily be edited and attributed by IDWR. 2009 landuse attributes were initially assigned by overlaying a rasterized version of the 1976/1992 Bear River Basin landuse classification with the CLU polygons. The polygons were assigned a landuse value based on the majority zonal statistic of the rasterized 1976/1992 land classification.

Although the CLU polygons required extensive editing to achieve the desired amount of detail needed for the project, using this dataset offered the advantage of providing greater detail compared to the 1976/1992 dataset. For example, some (but not all) rivers, roads, and urban areas were already delineated in the CLU dataset which was not the case in the 1976/1992 dataset. The CLU polygons were split roughly into thirds. Margie edited the Western 2/3 of the basin; Mike edited the Eastern 1/3 of the basin.

RASTER datasets

Natural color and color-infrared imagery acquired through the National Agricultural Inventory Program (NAIP) was heavily utilized for this project. NAIP imagery from 2004, 2006, and 2009 were available. The 2004 NAIP is true-color, 1-meter. The 2006 NAIP is true-color, 2-meter. The 2009 NAIP is available in both true-color and color-infrared. This 1-meter imagery was used as the primary source of background imagery. The initial landuse assessment was made by simple examination of 2009 NAIP imagery. Plant vigor and crop details are better revealed in the color-infrared band. Fields that appear to be cultivated and having an intense red color were classified as irrigated.

Black and white Digital Ortho Quarter Quads (DOQQs) were also used as reference, mostly for historical perspective. Seventy percent of the image dates for this raster dataset are 1992 with the remaining having an image date of 1993 or 1994.

False color Landsat satellite TM imagery was also referenced, mainly to see chronological (temporal) changes in field conditions, particularly early and late season irrigation. Wet soils on bare ground are easily distinguishable on Landsat imagery. The project area is covered by Landsat's World Reference System (WRS) Path 38, Rows 30 and 31. All scenes were collected from Landsat satellite TM which has 30-meter resolution. Scenes from the following 2009 dates were referenced: May 29, June 14, June 30, July 16, August 1, August 17, September 2, September 18.

Since Landsat satellite TM imagery was readily accessible in house, it was agreed that a Normalized Difference Vegetation Index (NDVI) would be a beneficial reference source. NDVI is a simple numerical indicator that can be used to analyze remote sensing measurements. It is directly related to photosynthetic capacity and energy absorption. NDVI values fall between -1.0 (water) and +1.0 (dense, photosynthetically active vegetation). However, upon further investigation, it was determined that measurements with a high NDVI value were not necessarily indicative of irrigated cropland due to higher than normal June 2009 precipitation and extensive wetland conditions in much of the project area along the Bear River and its tributaries. Further interpretation and field verification was required to determine irrigation practices in the area.

SUPPORTING LAND COVER datasets

In order to further refine the interpretation, data from the National Agricultural Statistics Service (NASS) 2009 Idaho Cropland Data Layer was utilized. NASS data is compiled nationwide, county by county, and is a raster, geo-referenced, crop-specific land cover data layer with a 56-meter ground resolution.

Another large-scale land classification dataset used for reference was the 2005 North American Land Cover Database produced as a joint project by Canada, The United States, and Mexico. The database has 250-meter spatial resolution and is in a provisional form.

The 1992 National Land Cover Dataset (NLCD92) prepared by the USGS was used as reference in questionable areas. From the NLCD92 metadata: "The National Land Cover Dataset is compiled from Landsat satellite TM imagery (circa 1992) with a spatial resolution of 30 meters and supplemented by various ancillary data (where available). The analysis and interpretation of the satellite imagery was conducted using very large, sometimes multi-state image mosaics (i.e. up to 18 Landsat scenes). Using a relatively small number of aerial photographs for 'ground truth', the thematic interpretations were necessarily conducted from a spatially-broad perspective… The NLCD classification contains 21 different land cover categories." The 1992 NLCD primarily served as support documentation in questionable areas.

OTHER SUPPORTING Datasets

Taxlot assessment codes for irrigated agriculture and irrigated pasture were referenced but found to be of little use for this project due to the lack of spatial detail provided.

National Hydrologic Database flow lines for the area were used to help determine location of canals and streams in making irrigation determinations. This dataset is under construction for the area but helped highlight details (canals, streams, ditches) that may have been unnoticed on the imagery.

The in-house WRedit extension for ArcGIS was used to spatially locate place of use (POU) and point of diversion (POD) for all active water right applications, permits, rights, and transfers in basins 11, 13, and 15. These basins have not been adjudicated.

BOUNDARIES AND SUBBASINS

The outer boundary of the Bear River Compact was created by following IDWR Administrative Basin boundaries which are derived from USGS 1:24k quad series maps.

The Biennial report from the April, 1992 Bear River Commission meeting minutes (Appendix F, page 3) states: "Compact divisions in Idaho are the Central and Lower. A surface water boundary, between the Central and Lower divisions, was developed to distinguish lands irrigated by surface water diverted from the Central Division, but are located in the Lower Division (below Stewart Dam)... Subbasin boundaries were taken from a research report (#125 by Hill et al), transferred to 1:100,000 topographic maps, and manually digitized. Subbasins are those areas described in report #125 for which unique consumptive water use was developed. Division and subbasin boundaries were edited to follow the PLSS QQ lines so each QQ and water right clearly falls into one division and subbasin."

Division and subbasin boundaries for 2009 were re-created using 4th and 5th field hydrologic unit boundaries (HUCs) as well as quarter/quarter public land survey boundaries (primarily around the groundwater and Central/Bear Lake subbasin boundaries). Division and subbasin boundaries from 2009 were used to calculate the changes in depletion in the table below.

PHOTOINTERPRETATION

Photointerpretation was completed by Margie Wilkins (western 2/3 of the project area) and Michael Verdun (eastern 1/3 of the project area). Initial landuse classification was assigned for each polygon based on an overlay of the rasterized 1976/1992 landuse classification and calculating the zonal majority. A methodical review was then performed section by section through all townships using 2009 NAIP and 2009 Landsat imagery, NDVI when appropriate, and other supplemental spatial information as noted above to determine the 2009 land use classification.

FIELD VERIFICATION

Hard copy maps with symbolized landuse classifications and 2009 NAIP and Digital Raster Graphic (DRG) backgrounds were used for field verification. Field verification was conducted in-house initially by consulting with Tim Luke and Corbin Knowles of the Water Distribution section. Here we utilized their familiarity with the basins to determine that certain fields initially

classified in 2009 as irrigated cropland based on high NDVI values were actually dry land cropland (non-irrigated cropland). Corbin and Tim also conducted some field verification when opportunities arose. GIS Analysts classifying irrigated acres, Margie Wilkins and Michael Verdun, spent 2 days in the field making final determinations of questionable areas.

GIS ANALYSIS Procedure used to Determine Land Use Change since 1976

As the 2009 photointerpretation / land use classifications were being conducted, errors in the 1976 land use classification were identified (most likely due to less sophisticated technology and the lower resolution imagery/datasets that were available in the 1990s). Initial comparisons between irrigated acres in 1976 and 2009 were inconsistent with available water right information. Consequently, an alternate approach was needed to determine areas of legitimate land use change between the 1976 classification (which appear to contain errors) and the 2009 classification.

Two analyses were conducted. In the first analysis, 1976 Irrigated Cropland and Wetlands/Naturally Subirrigated Pasture and Hay polygons were masked out (solid black) and all other 1976 land use categories were symbolized as hollow. 2009 Irrigated Cropland and Wetlands/Naturally Subirrigated Pasture and Hay polygons were symbolized as hollow and all other 2009 land use categories were masked out. Solid shapes for Active Water Permits and Water Rights with a priority date later than 1976 were underlayed below the landuse classifications allowing areas with no water right or permit visible (the background of the Data Frame was assigned a very bright yellow or magenta to show up vividly). Those areas where the brightly colored data frame or background imagery (false-color 2009 NAIP) showed through were areas where irrigated lands may have been brought into production and required further review. Graphic shapes were created around these areas for further review. 1976 and 2009 Landsat imagery was used for the review. If land use change was detected between the 1976 and 2009 Landsat images, then those polygons showing a change were attributed as “ADDED”. As a back-up review, all lands where water rights and permits with a priority date later than 1976 were reviewed.

In the second analysis, 1976 Irrigated Cropland and Wetlands/Naturally Subirrigated Pasture and Hay polygons were symbolized as hollow and all other 1976 land use categories were masked out (solid black). 2009 Irrigated Cropland and Wetlands/Naturally Subirrigated Pasture and Hay polygons were masked out and all other 2009 land use categories were symbolized as hollow. Solid shapes for Active Water Permits and Water Rights were underlayed below the landuse classifications allowing areas with no water right or permit to be visible. Those areas where background imagery (false-color 2009 NAIP) show through were designated as areas requiring further review to verify that acres were taken out of production. 1976 and 2009 Landsat imagery was used for the review. If land use change was detected between the 1976 and 2009 Landsat images, then those polygons showing a change were attributed as “REMOVED”.

WATER RIGHT ANALYSIS Procedure used to Determine New and Supplemental Acreage

New Irrigation

A review of all IDWR water rights within the Bear River drainage, having priority dates from January 1, 1976, thru December 31, 2009, was conducted. Lands or acres considered to be newly irrigated from water right information were then compared against the GIS data (data being the polygons or layer GIS staff considered to be new or "ADDED" land use/acres). Any area where there was overlap (new irrigated acreage found under both the GIS and water right review) was considered already counted in the GIS data. Acreage where the water right review suggested new irrigation, but GIS review had not found new irrigation, was flagged and given a second review by GIS staff.

Two half pivots located west of Soda Springs, just south of the highway were found to be new irrigation since 1976. Water right review confirmed the source to be groundwater. According to a paper published by the Idaho Geological Survey (Martin, M., Wylie, A., Otto, B. "Hydrogeologic Analysis of the Water Supply for Bancroft, Caribou County, Idaho." Idaho Geological Survey, Information Circular 61., 2005) the groundwater divide between the Portneuf and the Bear River Basins is south of the pivots. Those acres were not counted as new depletion because the source is not from the Bear River Basin.

Supplemental Irrigation

Water right review also included determining new supplemental irrigation (irrigation to firm the supply of a pre-January 1, 1976, water right). If a new water right (priority between 1976 and 2009) overlaid ground that had a pre-1976 water right, and appeared irrigated in 2009, the authorized acreage for the supplemental right was counted. If the ground did not appear irrigated in 2009, the supplemental acreage was typically not counted. There were instances where authorized acres under the supplemental right did not appear irrigated in 2009, but review of imagery from years 2007, 2008, and 2010 did show evidence of irrigation. These were treated on a case by case basis to determine whether or not to count supplemental acreage. There were also areas where a supplemental right was only partially counted. For example, 40 acres had both a pre-1976 right and post-1976 supplemental right appurtenant. However, 10 of the 40 acres would be a rock pile or hill side, so those 10 acres were not counted.

This methodology highlights land use changes regardless of misclassifications in the 1976 dataset.

New Acreages by Subbasin for Irrigated Cropland and Wetlands/Naturally Subirrigated Pasture and Hay

CENTRAL DIVISION	ACREAGE (ac)	DEPLETION RATE (af/ac)*	DEPLETION (af)
Thomas Fork subbasin	511	1.04	531
Bear Lake subbasin	340	1.01	343
Cokeville subbasin	0	1.04	0
TOTAL	**851**		**874**
LOWER DIVISION			
Bear Lake subbasin	198	1.01	200
Soda Spring subbasin	309	1.01	312
Oneida subbasin	118	1.00	118
Cache Valley subbasin	281	1.00	281
Malad subbasin	838	1.18	989
Tremonton subbasin	559	1.09	609
TOTAL	**2,303**		**2,509**

**Depletion Rates obtained from: Amended Bear River Compact Commission-Approved Procedures, Appendix B*

New Acreages by Subbasin for Supplemental Irrigation

CENTRAL DIVISION	ACREAGE (ac)
Thomas Fork subbasin	739
Bear Lake subbasin	0
Cokeville subbasin	0
TOTAL	**739**
LOWER DIVISION	
Bear Lake subbasin	315
Soda Spring subbasin	178
Oneida subbasin	1,224
Cache Valley subbasin	2,420
Malad subbasin	4,400
Tremonton subbasin	387
TOTAL	**8,924**

Idaho's Estimate of Depletion for Supplemental Rights Using the PCC Method

Idaho estimated supplemental irrigation depletion using estimates of ground water pumping based on power consumption records from Utah Power for electric-driven pumps. Most of the post-1976 supplemental rights in the Bear River Basin in Idaho are from a ground water source, and most of those deliver water by pumping to a sprinkler system. Annual depletion can be estimated by applying an efficiency factor for sprinkler systems to the estimate of annual volume of water pumped.

The Power Consumption Coefficient (PCC) method estimates volume of water pumped based on a relationship between the power demand (KW) at the pump motor and the flow discharged from the pump to the irrigation system. Once the PCC is determined for a specific system, the annual power usage (KWh) can be converted to annual volume pumped. The PCC method can provide a reasonable estimate of volume pumped if the power records are available, the flow is known or can be reasonably estimated, and the KW demand and flow are relatively stable throughout the season.

Power consumption records and other data for the 2003 to 2012 period were used to estimate PCC. Idaho Department of Water Resource Water Right Section staff researched available information to determine the PCC for about 100 water rights that were previously identified as supplemental rights as part of the land classification effort (see Idaho Portion Bear River Compact, Internal Report, April 12, 2012). Staff used water right records, County Taxlot (ownership) records, aerial imagery and data from the Spatial Dynamics well inventory collected in 1999 to match power records with specific wells and determine irrigated acreage, type of irrigation system, pump horsepower, flow, overlapping water rights, and number of wells/pumps per system. The attached worksheet was used to compile the data and calculate PCC and annual volume for each water right.

After gathering the data, staff calculated a PCC, determined the annual volume pumped, and applied an efficiency factor to determine annual depletion. The efficiency for each system was estimated based on published values for sprinkler irrigation systems. After researching data for the approximately 100 supplemental water right records, a PCC was calculated for about one third of those records. Many of the wells could not be successfully matched to power records. Some systems were diesel or gas powered, and many systems included multiple wells or multiple rights. Further review eliminated systems that were determined to be operating as a primary source. The end result was only 14 water right records (only two in the Central Division) where a PCC was determined to represent supplemental use. The attached spreadsheet table provides information and results for the water rights where a PCC was calculated, and those identified as representing depletions for supplemental use.

A weighted average of depletion per supplemental acre was calculated based on the total depletion and acreage irrigated under the supplemental rights. The depletion was only estimated for two rights in the Central Division using the PCC method, but those two rights represent almost half of the total acreage indentified as supplemental since 1976 for the Central Division. Results of the depletion estimates are 0.59 acre-feet per acre in the Central Division and 0.69 acre-feet per acre in the Lower Division in Idaho.

The resultant depletion estimates were applied to the total number of acres previously identified as supplemental from the land classification effort. This included those systems that converted a post-1976 supplemental water right to primary use on lands identified as irrigated prior to 1976. If the pre-1976 primary water rights have been retained as unused on those acres, the net increase in depletion since 1976 should be limited to the difference between the pre-1976 primary right depletion and the

post-1976 total depletion. Our best estimate of that increase in depletion is to apply the PCC weighted average to those acres. If the pre-1976 water rights have been moved to some previously un-irrigated land, the new acreage depletion would have been counted as new irrigation in the land classification effort. In that case, the net increase in depletion since 1976 is the new acreage depletion (already counted) plus the post-1976 total depletion on the original acres minus the pre-1976 primary right depletion on the original acres. The end result is the same and is estimated by applying the PCC weighted average to the acreage originally identified as supplemental.

In the Central Division, 739 supplemental acres deplete 436 acre-feet per year. In the Lower Division, 8,924 acres deplete 6,158 acre-feet per year.

Idaho's Estimate of Depletion for Supplemental Rights in Bear River Basin Using PCC Method

WR No.[1]	Sub-Basin	Division	Priority Date	Ave. Annual Diversion Volume (AF)	Estimated Application Efficiency[2]	Estimated Annual Depletion (AF)	Irrigated Acres	Depletion per Acre (AF/ac)	Notes
11-7135	Thomas	Central	9/27/1977	381.5	0.60	228.9	211.0	1.08	likely used as primary
11-7155	Thomas	Central	12/11/1978	287.3	0.68	195.364	181.0	1.08	likely used as primary
11-7120A	Thomas	Central	5/25/1977	192.5	0.75	144.375	270.0	0.53	Volume for 11-7120A, 11-7120C, 11-7673 & 11-7674
11-7121	Thomas	Central	6/10/1977	104.3	0.60	62.58	77.0	0.81	
11-7120C	Thomas	Central	5/25/1977						See 11-7120A
11-7120B	Thomas	Central	5/25/1977						Split into 11-7673 & 11-7674 June 2010. See 11-7120A
11-7673	Thomas	Central	5/25/1977						See 11-7120A
11-7674	Thomas	Central	5/25/1977						See 11-7120A
15-7110	Malad	Lower	12/30/1988	0	0.60	0	146.0	0.00	2 yrs only, 146 acres per 1992 proof b/u, insignificant use
15-7255	Malad	Lower	12/4/2003	4.8	0.60	2.88	4.8	0.60	acreage and rate unreliable, do not use
15-7264	Malad	Lower	8/16/2004	154	0.60	92.4	60.0	1.54	power records don't match permit records, do not use
15-7226	Malad	Lower	5/29/2002	25.3	0.60	15.18	17.0	0.89	used as primary - app. notes sw supply is not useable
13-7392	Cache	Lower	5/27/1983	34.9	0.60	20.94	88.6	0.24	
13-7695	Cache	Lower	5/4/1977	32.8	0.60	19.68	44.0	0.45	5 years, volume is proportional to acres from original 13-7179
13-7696	Cache	Lower	5/4/1977	16.4	0.60	9.84	22.0	0.45	5 years, volume is proportional to acres from original 13-7179
15-7244	Malad	Lower	4/21/2003	109	0.60	65.4	53.0	1.23	used as primary - app. notes no sw rights
13-7179	Cache	Lower	5/4/1977	56.4	0.60	33.84	66.0	0.51	5 years then split into 13-7695 & 13-7696
15-7115	Malad	Lower	12/21/1989	18.9	0.68	12.852	24.0	0.54	2 yrs only
15-7146	Malad	Lower	9/20/1994	44.6	0.60	26.76	44.5	0.60	estimated pcc volume based on proportional use with 15-2039B
13-7116	Cache	Lower	6/23/1988	70	0.60	42	202.0	0.21	overlaps pre-76 wr, majority is primary
15-7150	Malad	Lower	4/24/1995	87.9	0.60	52.74	58.0	0.91	
15-7288	Malad	Lower	6/20/2007	96.1	0.60	57.66	33.0	1.75	used as primary, developed in 2009 as alternate for senior artesian wells
15-7155	Malad	Lower	9/30/1996	102.4	0.75	76.8	116.0	0.66	used as primary - water user indicates shares not delivered
11-7374	Bear	Lower	4/5/1989	67.8	0.60	40.68	91.0	0.45	
15-7153	Malad	Lower	5/5/2003	112.2	0.60	67.32	110.0	0.61	
15-7154	Malad	Lower	8/12/1996	115.92	0.60	69.552	64.0	1.09	used as primary
15-7127	Malad	Lower	3/29/1991	149.3	0.60	89.58	92.5	0.97	
13-7476	Cache	Lower	10/29/1990	243.5	0.60	146.1	185.0	0.79	
15-7158	Malad	Lower	11/9/2009	70	0.60	42	40.0	1.05	likely used as primary
15-7312	Malad	Lower	4/28/1995	341	0.60	204.6	224.0	0.91	used as primary
13-7165	Oneida	Lower	4/6/1977	296.0	0.68	201.28	156.0	1.29	well serves multiple rights in a 799-acre PPU, including pre-76 right
15-7048	Malad	Lower	10/6/1978	303.2	0.60	181.92	59.0	3.08	only 19 out of 59 acres supplemental
13-7198A	Oneida	Lower	6/20/1977	344	0.75	258	193.0	1.34	likely used as primary
13-7147	Oneida	Lower	1/19/1977	531.0	0.68	361.08	313.0	1.15	well also serves 306 acres under 13-7099 with interconnected wells
15-7230	Malad	Lower	7/8/2002	360	0.68	244.8	278.0	0.88	
13-7389	Cache	Lower	5/24/1983	714.8	0.68	486.064	560.0	0.87	well covers multiple rights, mostly primary acres
13-7134	Cache	Lower	8/20/1976	939	0.68	638.52	240.0	2.66	one of two wells and rights for 558 acres POU, mostly primary

Results: weighted average in Central Division = 0.59 AF/ac; weighted average in Lower Division = 0.69 AF/ac; weighted average for basin = 0.67 AF/ac; records used in averages are highlighted

1. PCC was not calculated for other supplemental rights due to: inability to match power records to pump; use of diesel/gas motor or gravity flow system; multiple source/right/use at pump; or use as primary right.
2. Efficiencies were estimated using guidelines from the Report Regarding Evaluation of Irrigation Diversion Rates in SRBA dated 01-14-1999 (0.75 for pivot and 0.6 for hand/wheel lines).

Bear River Basin Analysis of Depletion
Attributable to a Supplemental Ground Water Right

Reviewer: _____ Date: _____

Water Right Number(s): _____

Review Procedure

1. Use the general water right and/or permit shapefiles prepared by Nick Van Dyke to identify the place of use water right location and size. Record the number of supplemental acres irrigated from the water right or permit. Note that the shapefile may be a nominal shape and therefore larger than the authorized number of acres. Acres: _____

2. Review 2009 aerial imagery and the 2009 land use shape. Check all that apply (a, b, or c) for the POU. Generally describe the irrigation system if more than one application method is used.

   Notes

   a. __ Pivot
   b. __Gravity
   c. __Wheel lines/Hand Lines

3. Confirm the water right point of diversion location from the water right file and the Spatial Dynamics data (GPS_Wells table in Access). The water right and Spatial Dynamics should have the same site tag ID. Record the Power Meter Serial No. (PWRMTR_SN) from GPS_Wells.

   Site Tag ID: _____ Power Meter Serial No.: _____

   Notes:

4. Does the well serve as point of diversion for multiple water rights? _____

   If "Yes", list the right nos._____

5. Using the 2003 power consumption data (spreadsheet) submitted by Utah Power (UPL) and the Power Meter Serial No. from step 4 (leading zero is not included in the UPL data files) for the point of diversion, find and enter the UPL Service ID: _____

   Note: Check or confirm the horsepower (HP) rating from the Spatial Dynamics table, UPL, and the water right field report to make sure they match. Also, check the tax lot owner against the UPL account name. Note any serious discrepancies.

6. For the years 2003 through 2012, look at the UPL power consumption data and fill in the table below for power demand (KW) and kilowatt hours (kWh). Since the KW may vary as sprinkler lines come on and off, etc., this may take some interpretation.

Year	Representative KW*	Annual kWh Total	Notes
2003			
2004			
2005			
2006			
2007			
2008			
2009			
2010			
2011			
2012			
10-year Total			
10-year Avg.			

KW should be about 0.746 x horsepower. Or, horsepower should be about 1.34 x KW.

7. Compute Power Consumption Coefficient (PCC):
    a. Determine the diversion rate for the water right: _____gpm
    (Use best available rate from the field report unless Spatial Dynamics horsepower or other available data provides a better estimate.) Explain the basis of diversion rate used:

    b. Insert average annual KW from the table in item 6:_____

    c. PCC = (KW x 5431)/(gpm) = kWh/ac.ft. = _____

8. Using PCC from step 7.c and the 10-year average kWh from step 6, calculate the average volume diverted per year.

    kWh/PCC = Average volume (af/yr) diverted = _____

9. The data from step 8 will be recorded in a spreadsheet and multiplied by an estimated efficiency (based on the entries in step 2) to estimate average annual depletion (consumptive use).

Appendix B | Utah Mapping Detail

Water-Related
Land Use
Inventories

UTAH

Bear River Basin 2009 Inventory

(Bear River Commission Boundary)

UTAH DNR WATER RESOURCES

A Water-Related Land Use Inventory Report of the Bear River Basin

Prepared by:

Utah Department of Natural Resources
Division of Water Resources

Report Compiled:
June 2011

ACKNOWLEDGMENTS

This report was prepared by Eric Edgley, Technical Services Manager. The land use data summarized in this report were gathered under the direction of Todd Adams, Assistant Director, and supervised by Eric Edgley, Section Chief, Technical Services, Utah Division of Water Resources.

The Technical Services Staff was chiefly responsible for the collection, preparation and analyses of the data. The data were summarized by Barbara Perry, GIS Analyst. Additionally, select members of the Planning and Development Staffs assisted with the collection of the data.

This report was reviewed by

Dennis J. Strong, Director
Todd Adams, Assistant Director
Eric Edgley, Section Chief, Technical Services
Eric Klotz, Section Chief, Water Conservation & Education
Todd Stonely, Section Chief, River Basin Planning

_____

Dennis J. Strong, Director

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BEAR RIVER BASIN
WATER-RELATED LAND USE INVENTORY

INTRODUCTION

Authority

In the 1963 general session, the Utah State Legislature charged the Division of Water Resources with the responsibility of developing a State Water Plan. This plan is to coordinate and direct the activities of state and federal agencies concerned with Utah's water resources. As a part of this objective, the Division of Water Resources collects water-related land use data for the entire state. This data includes the types and extent of irrigated crops as well as information concerning phreatophytes[I], wet/open water areas, dry land agriculture and residential/industrial areas.

The data produced by the water-related land use program are used for various planning purposes. Some of these include: determining cropland water use, evaluating irrigated land losses and conversion to urban uses, planning for new water development, estimating irrigated acreages for any area, and developing water budgets. Additionally, the data are utilized by many other state and federal agencies.

Previous Methods

The land use inventory methods used by the division in conducting water-related land use studies have varied with regard to the procedures used and the precision obtained. During the 1960s and 70s, inventories were prepared using large format vertical -aerial photographs supplemented with field surveys to label boundaries, vegetation types, and other water use information.

After identifying crops and labeling photographs, the information was transferred onto a base map and then planimetered[II] or "dot-counted" to determine the acreage. Tables for individual townships and ranges were prepared showing the amount of land in each land use category within each section. Data were then available for use in preparing water budgets.

In the early 1980s, the division began updating its methodology for collecting water -related land use data to take advantage of the rapidly growing fields of Remote Sensing and computerized Geographic Information Systems (GIS).

For several years during the early 1980's, the division contracted with the University of Utah Research Institute, Center for Remote Sensing and Cartography (CRSC), to prepare water-related land use inventories. During this period, water-related land use data was obtained by using high altitude color infrared photography and laboratory interpretation, with field checking.

In March 1984, several division staff members visited the California Department of Water Resources to observe its methodology for collecting water-related land use data for state water planning purposes.

Based on its review of the California methodology and its own experience, the division developed a water-related land use inventory program. This program included the use of 35mm slides, United States Geological Survey (USGS) 7-1/2 minute quadrangle maps, field-mapping using base maps produced from the 35mm photography and a computerized GIS to process, store and retrieve land use data.

Areas for survey were first identified from previous land use studies and any other available information. The identified areas

were then photographed using an aircraft carrying a high quality 35mm single lens reflex camera mounted to focus along a vertical axis to the earth. Photos were taken between 6,000 and 6,500 feet above the ground using a 24mm lens. This procedure allowed each slide to cover a little more than one square mile with approximately 30 percent overlap on the wide side of the slide and 5 percent on the slide's narrow side.

The slides were then indexed according to a flight-line number, slide number, latitude and longitude. All 35mm slides were stored in files at the division offices and cataloged according to township, range and section, and quadrangle map location.

Water-related land use areas were then transferred from the slide to USGS 7-1/2 minute quadrangle maps using a standard slide projector with a 100-200mm zoom lens. This step allowed the technician to project the slide onto the back of a quadrangle map. The image showing through the map was adjusted to the map scale with the zoom lens. Field boundaries and other water-use boundaries were then traced on the 7-1/2 minute quadrangle map.

Next, a team was sent to use the map in the field to check the boundaries and current year land use field data on the 7-1/2 minute quadrangles.

The final step was to digitize and process the field data using ARC/INFO software developed by Environmental Systems Research Institute (ESRI).

Present Methodology

Starting in 2000 with the land use survey of the Uintah Basin, the division further improved its land use program by using digital data for the purposes of outlining agricultural and other land cover boundaries. The division uses satellite data, USGS Digital Orthophoto Quadrangles (DOQs), National Agricultural Imagery Program (NAIP), and other digital images in a heads-up digitizing[III] mode for this process. This allows the division to use multiple technicians for the digitizing process.

Digitizing is done as line and polygon files using ArcMap 9.3 or ArcView 3.2 with a satellite image or DOQ image as a background with other layers added for reference. Boundary files are created in logical groups so that the process of edge-matching along quad lines is eliminated and precision is increased. All boundaries of individual agricultural fields, urban areas, and significant riparian areas are precisely digitized.

Once the process of boundary digitizing is done, boundary line files are converted to polygons and loaded onto tablet PCs. Field crews are then sent to label and field check the boundary file as well as the crop or land cover type for each polygon. Each tablet PC is attached to a GPS unit for real-time tracking to continuously update the field crew's location during the field labeling process. This improved process has saved the division much time and money and even greater savings will be realized as the new statewide field boundaries are completed. When the time comes to re-inventory a basin, existing boundaries will be used and will only be modified in areas where they have actually changed.

Once processed and checked, the data is filed in the State Geographic Information Database (SGID) maintained by the State Automated Geographic Reference Center (AGRC). Once in the SGID, the data becomes available to the public. At this point, the data is also ready for use in preparing various planning studies.

In conducting water-related land use inventories, the division attempts to inventory all lands or areas that consume or evaporate water other than natural precipitation. Areas not inventoried are mainly desert, rangeland and forested areas.

Wet/open water areas and dry land agriculture areas are mapped if they are within or border irrigated lands. As a result, the numbers of acres of wet/open water areas and dry land agriculture reported by the division may not represent all such areas in a basin or county.

During land use inventories, the division uses 11 hydrologic basins as the basic collection units. County data is obtained from the basin data. The water-related land use data collected statewide covers more than 2,700,000 acres of dry and irrigated agricultural land. This represents about 5 percent of the total land area in the state.

BEAR RIVER BASIN
WATER-RELATED LAND USE DATA

Basin Description

The Bear River Basin proper, covers large portions Idaho, Wyoming, and Utah. Utah claims approximately 2,163,000 acres of the Bear River Basin spanning parts of Box Elder, Cache, Summit and Rich counties. The Utah portion of the basin is bordered on the north by the Utah/Idaho state line and on the east by the Utah/Wyoming state line. The Promontory mountains largely form the western boundary, while the Box Elder, Cache, and Rich counties lines largely comprise the basin's southern boundary. The Utah portion of the basin is further divided into the Lower Bear, Cache Valley and Upper Bear hydrologic sub-basins.

The climate varies widely with the physiography of the basin. Precipitations range from roughly 9 inches per year at low elevations (4,200 feet) to more than 40 inches at high elevations (12,700 feet). Vast amounts of water are stored in reservoirs and glacial lakes at high elevations and feed the basin's river systems in the spring and summer months. In addition, the higher elevations experience short, mildly warm summers and long, cold winters. At lower elevations, temperatures and seasons are more moderate and less varied. Notable features of the basin include Bear Lake and Logan Canyon.

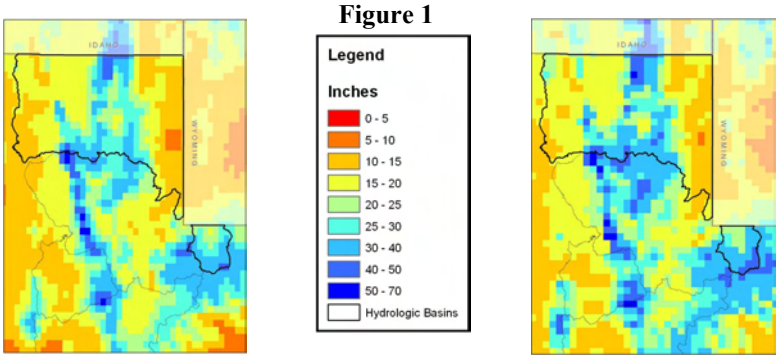
Census data indicate a 2000 population of 136,097 in the Utah portion of the Bear River Basin. Roughly 67 percent of that population resides in Cache County, 31 percent in Box Elder County, and 1.4 percent in Rich County. The basin's largest cities include Logan (pop. 42,670) and Brigham City (pop. 17,411).

Data Collection

The Division inventoried water-related land use in the Bear River Basin during the summer of 2009. Previous inventories were done in 1969*, 1986, 1996, and 2003. In 2009, the division inventoried nearly 599,053 acres of agricultural land in the Bear River Basin. This represents roughly 20 percent of

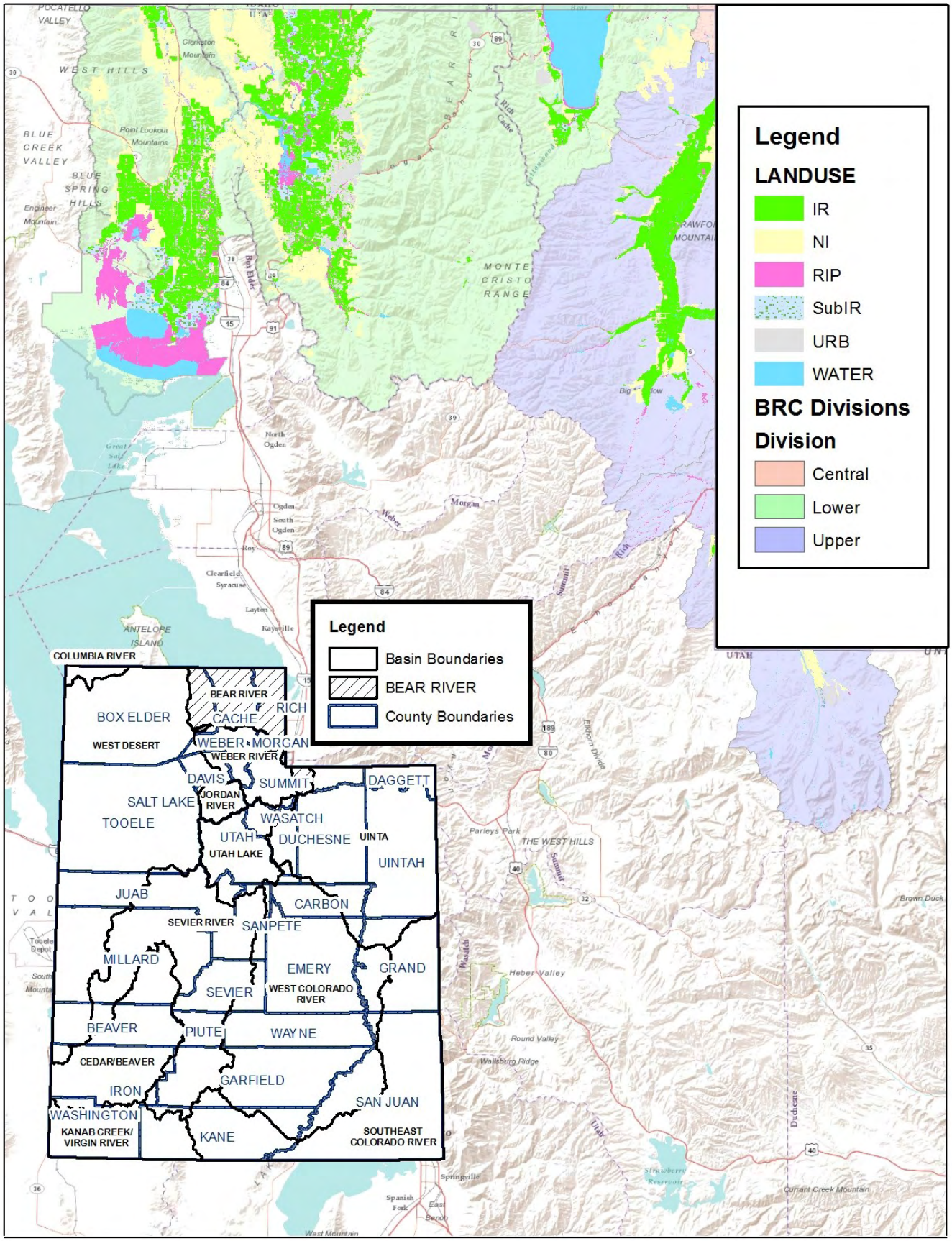
Figure 1

Annual Precipitation For 2009



Average Annual Precipitation 1971 to 2000

Figure 2 Mapped Water-Related Land Use in 2009 and Basin Location



the total land area in the entire basin. Figure 2 illustrates the water-related land use of the basin and shows that most of the agricultural land use occurs on the more populated areas on the western edge of the basin.

Data Summary

Figure 3 delineates four categories of water-related land use by percentage and acreage.

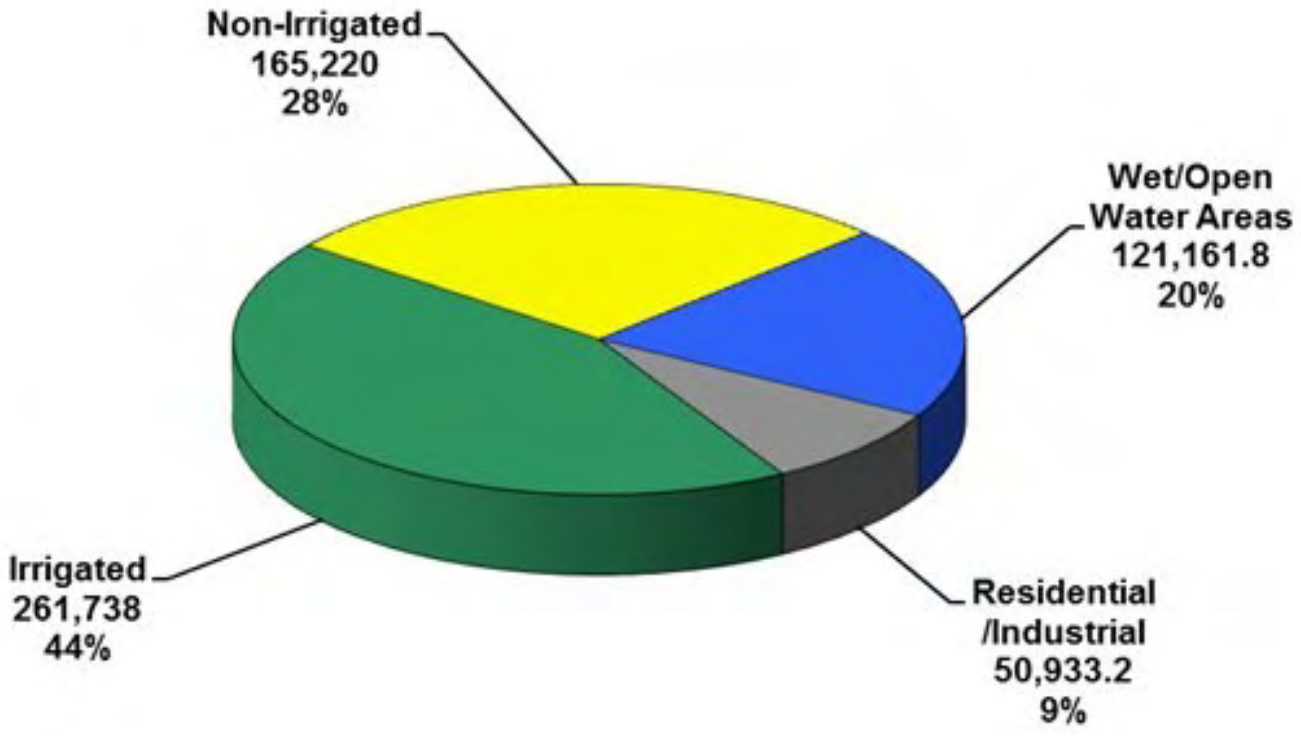
Of the 599,053 agricultural acres inventoried in 2009, 261,738 acres were irrigated lands (including land that was sub-irrigated), and 165,220 were non-irrigated (including land that was fallow and idle). Other categories that were inventoried include: 121,162 of wet/open water areas (including reservoirs and mountain lakes), and 50,933 were residential/industrial areas (including farmsteads and rural housing).

The division has further classified the water-related land use within the basin. Figure 4 represents data from the surface irrigated and sub-irrigated cropland categories. The data are broken down into 14 different subcategories.

Total basin acreage for irrigated lands, non-irrigated lands, wet/open water areas, and residential/industrial are presented in Table 1 by county. Table 2 provides a comparison of acreage totals by survey year.

* The data collected in 1969 are available in book form at the Utah Division of Water Resources

Figure 3 Delineation of Water-Related Land Use Categories within the Bear River Basin in 2009.



Due to changes in methodology, improvements in imagery, and upgrades in software and hardware, increasingly more refined inventories have been made in each succeeding year of the Water-Related Land Use Inventory. While this improves the data we report, it also makes comparisons to past years difficult. Making comparisons between datasets is still useful; however, **increases or decreases in acres reported should not be construed to represent definite trends or total amounts of change up or down.** To estimate such trends or change, more analysis is required.

Figure 4 Breakdown of Irrigated Cropland within the Bear River Basin in 2009

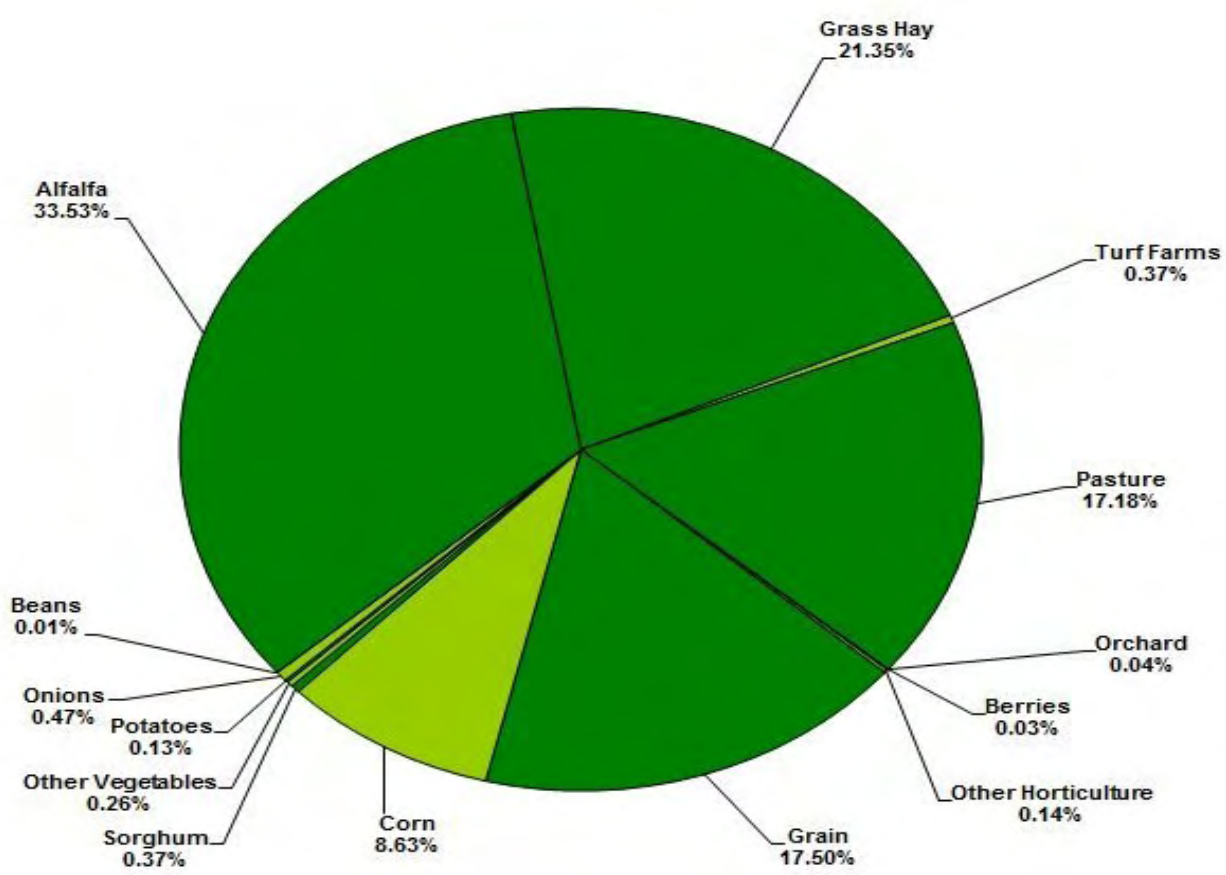


Table 1 Bear River Basin Land Use Summary of Land Cover by County for 2009

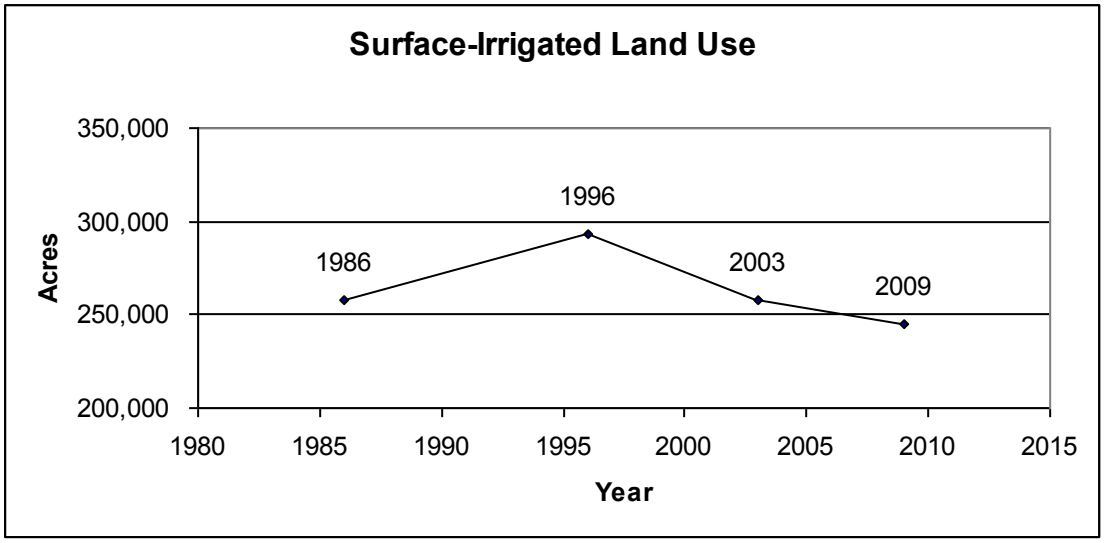
BEAR RIVER BASIN (BRC) LAND USE 2009 (Acres)						
	Cover	**Box Elder**	**Cache**	**Rich**	**Summit**	**Basin**
Surface-Irrigated						
	Orchard	22.9	71.2	0.0	0.0	94.2
	Vineyard	0.0	0.0	0.0	0.0	0.0
	Berries	0.0	77.9	0.0	0.0	77.9
	Other Horticulture	224.0	82.1	29.9	0.0	335.9
	Grain	21,222.1	18,219.4	1,750.2	0.0	41,191.8
	Corn	11,695.6	8,624.4	0.0	0.0	20,320.0
	Sorghum	368.4	500.0	0.0	0.0	868.4
	Other Vegetables	233.7	368.2	0.7	0.0	602.6
	Potatoes	0.0	271.6	23.7	0.0	295.3
	Onions	1,117.8	0.0	0.0	0.0	1,117.8
	Beans	0.0	29.1	0.0	0.0	29.1
	Tomatoes	0.0	0.0	0.0	0.0	0.0
	Alfalfa	27,955.2	44,629.7	6,358.0	0.0	78,942.9
	Grass Hay	4,655.6	7,684.1	37,730.9	186.6	50,257.2
	Turf Farms	798.3	70.7	0.0	0.0	869.0
	Pasture	4,007.8	16,336.4	20,095.6	0.0	40,439.9
	Subtotal	**72,301.6**	**96,964.8**	**65,989.0**	**186.6**	**235,441.9**
Sub-Irrigated						
	Pasture-subirrigated	14,699.3	8,215.9	1,416.8	110.5	24,442.6
	GrassHay-subirrigated	625.9	737.4	490.0	0.0	1,853.3
	Subtotal	**15,325.2**	**8,953.4**	**1,906.8**	**110.5**	**26,295.9**
Non-Irrigated						
	Fallow-Irrigated Land	3,870.6	1,243.1	14.4	0.0	5,128.1
	Idle-Irrigated Land	3,911.9	7,297.4	2,653.0	0.0	13,862.4
	Dry Grain/Seeds	8,283.8	15,933.4	667.5	0.0	24,884.7
	Dry Safflower	1,599.5	7,036.0	0.0	0.0	8,635.5
	Dry Alfalfa	2,893.8	11,855.7	198.2	0.0	14,947.6
	Dry Pasture	22,792.0	6,241.9	22,698.9	426.2	52,159.1
	Dry Fallow	3,622.2	4,944.5	0.0	0.0	8,566.7
	Dry Idle	6,418.6	15,585.3	3,042.7	24.7	25,071.4
	Subtotal	**53,392.3**	**70,137.4**	**29,274.8**	**451.0**	**153,255.5**
Other Non-Irrigated						
	Range Pasture	**1,726.8**	**3,832.0**	**2,414.6**	**3,991.0**	**11,964.4**
Wet/Open Water Areas						
	Riparian	39,998.5	8,217.0	4,293.3	257.1	52,766.0
	Streams	2,190.7	1,188.7	1,084.0	278.4	4,741.8
	Reservoirs	120.4	4,067.7	1,627.5	199.6	6,015.3
	Lakes & Ponds	20,004.0	913.4	34,827.9	722.7	56,468.0
	Sewage Lagoon	16.1	1,011.5	34.4	0.0	1,062.0
	Evaporation Pond	15.4	48.6	43.5	1.2	108.7
	Subtotal	**62,345.1**	**15,446.9**	**41,910.8**	**1,459.0**	**121,161.8**
Residential/Industrial						
	Urban	11,217.0	29,980.3	5,590.2	1,969.7	48,757.2
	Urban Grass/Parks	379.7	1,658.5	137.7	0.0	2,175.9
	Subtotal	**11,596.7**	**31,638.9**	**5,727.9**	**1,969.7**	**50,933.2**
Total Land Use/Land Cover		**216,687.7**	**226,973.3**	**147,223.8**	**8,167.8**	**599,052.6**

Table 2 Comparison of Land Cover Totals by Inventory Year*

BEAR RIVER BASIN (BRC) LAND USE (Acres)					
	Box Elder	Cache	Rich	Summit	Basin Total
1986 Land Use Summary					
Surface-Irrigated	70,668.5	42.5	65,580.9	2,584.2	244,367.1
Sub-Irrigated	8,397.0	0.2	6,077.3	0.0	21,432.0
Non-Irrigated	51,635.1	5.7	14,613.1	0.0	128,945.2
Other Non-Irrigated	0.0	0.0	0.0	0.0	0.0
Wet/Open Water Areas	95,627.3	8.1	39,931.0	998.6	156,360.6
Residential/Industrial	6,033.6	1.1	5,489.4	555.4	31,092.1
Total land use/Land Cover	**232,361.5**	**57.6**	**131,691.7**	**4,138.2**	**582,197.0**
1996 Land Use Summary					
Surface-Irrigated	83,888.2	116,889.4	72,056.8	2,944.6	275,779.1
Sub-Irrigated	5,835.7	4,919.2	324.2	173.7	11,252.8
Non-Irrigated	39,522.1	49,566.5	18,049.9	0.0	107,138.5
Other Non-Irrigated	0.0	0.0	0.0	0.0	0.0
Wet/Open Water Areas	22,721.4	17,867.0	41,171.5	2,071.9	83,831.8
Residential/Industrial	7,570.0	23,480.0	3,121.9	981.1	35,153.0
Total land use/Land Cover	**159,537.5**	**212,722.1**	**134,724.4**	**6,171.3**	**513,155.2**
2003 Land Use Summary					
Surface-Irrigated	81,990.2	103,029.6	55,590.4	3,289.9	243,900.1
Sub-Irrigated	9,090.3	9,419.8	15,068.1	465.6	34,043.8
Non-Irrigated	51,498.5	66,778.6	31,244.4	1,564.4	151,085.8
Other Non-Irrigated	0.0	0.0	0.0	0.0	0.0
Wet/Open Water Areas	70,914.3	14,563.7	44,507.0	1,495.4	131,480.4
Residential/Industrial	11,204.5	30,313.9	7,320.3	2,412.6	51,251.3
Total land use/Land Cover	**224,697.8**	**224,105.6**	**153,730.3**	**9,227.9**	**611,761.4**
2009 Land Use Summary					
Surface-Irrigated	72,301.6	96,964.8	65,989.0	186.6	235,441.9
Sub-Irrigated	15,325.2	8,953.4	1,906.8	110.5	26,295.9
Non-Irrigated	53,392.3	70,137.4	29,274.8	451.0	153,255.5
Other Non-Irrigated	1,726.8	3,832.0	2,414.6	3,991.0	11,964.4
Wet/Open Water Areas	62,345.1	15,446.9	41,910.8	1,459.0	121,161.8
Residential/Industrial	11,596.7	31,638.9	5,727.9	1,969.7	50,933.2
Total land use/Land Cover	**216,687.7**	**226,973.3**	**147,223.8**	**8,167.8**	**599,052.6**

* Please refer to the word of caution on page 6 regarding comparisons between datasets.

Figure 5 Surface Irrigated Land Use Comparison Graph



Data Access

GIS data used in this summary may be downloaded from the Utah AGRC. Current land use datasets are available as a statewide layer or by county and are offered in shapefile and geodatabase formats. To download the most recent dataset, Go to:

http://www.water.utah.gov/Planning/landuse/index.htm

For past GIS datasets, Please contact Technical Services at the Division of Water Resources

Past Land Use Reports for this area and a PDF of this report can be found at
http://www.water.utah.gov/planning/landuse/publ.htm
Metadata is available at
http://www.water.utah.gov/planning/landuse/gisdata.htm
Additional Bear River Basin reports as well as many other reports can be found at
http://www.water.utah.gov/planning

REFERENCES

1. Utah State Water Plan, Bear River Basin,
Utah Division of Water Resources, January 2004.

2. Prism Group, Oregon State University, http://prism.oregonstate.edu/
Maximum and Minimum precipitation calculated using Zonal Statistics tool with ESRI ArcInfo
ftp://prism.oregonstate.edu//pub/prism/us_30s/grids/ppt/Normals/us_ppt_1971_2000.14.gz
ftp://prism.oregonstate.edu//pub/prism/us/grids/ppt/2000-2009/us_ppt_2010.14.gz

GLOSSARY

I. Phreatophyte - A deep-rooted plant that obtains water from a permanent ground supply or from the water table.

II. Planimetered or dot-counted - process to determine acreage by assigning an acreage value to a "dot" based on map scale and then counting the number of "dots" within a specific boundary.

III. Heads-up digitizing - Manual digitization by tracing a mouse over features displayed on a computer monitor, used as a method of vectorizing raster data.

Supplemental Irrigation Depletion

Utah Method for Evaluating Depletion for "Other" Supplemental Water Rights

"Other" supplemental water rights are those that supply individual fields or farms that are not covered by supplemental "project" water rights. A water right with a post-1976 priority date that covers lands under 1976 BRC mapping is classified as supplemental. Estimated supplemental "supply" rates for individual water rights are based on contacts with irrigators and review of "sole supply" values and are determined on a case-by-case basis at the field level as reported in the table. Supply depletion factors are either the sole supply acres percentage of the whole acres or estimates from irrigators contacted. The sole supply depletion value was calculated by multiplying acres by the depletion rate times the supply depletion factor. As was expected, this method revealed depletions 3 to 5 times greater than those that would be reported using a sub-basin shortage rate.

These are shown in comparison to depletion that would be reported using a sub-basin shortage rate as was used in the 1992 report.

Examples of Case-by-Case Evaluations

1) Water right 23-3473 – a right to supplementally irrigate 93.8 acres that are covered by shares in Crawford Thompson Canal in the Upper Division. Division of Water Rights staff contacted the applicant who estimated that the supplemental source supplies 53% of the use based on the acreage that is sprinkle irrigated that would otherwise be difficult to irrigate with the canal.

2) Water right 23-3518 – a right to supplementally irrigate 172.6 acres that are irrigated by rights in Woodruff Creek. Later in the irrigation season the creek rights are insufficient to supply the use and the well is used instead. Based on the evaluation by Division of Water Rights staff at the time the water right was perfected, a "sole supply" limitation of 90 acres was given, which equates to a supply rate of 52%.

3) Water right 25-7469 – a right to supplementally irrigate 65 acres that are irrigated by shares in Cub River Irrigation Company and a pre-1976 water right. It was filed with a sole supply limitation of 40 acres. Division of Water Rights staff contacted the applicant who estimated that the supplemental source (a pumped well) now supplies 15% of the use through a sprinkle irrigation system.

Calculated Values of Depletion for Supplemental Post-1976 Appropriations Out of the Bear River Drainage in Utah

			2009 Supplemental Depletion Estimate					Old Supplemental Shortage Methodolgy (for compairson purposes only)	
Water Right #	Name	Priority (Y-M-D)	Acres	Sole supply acres	Depletion af/ac	"Supply" Depl. Factor	Depletion (acre-feet)	"Shortage" Depl. Factor	Depletion (acre-feet)
21-1471	Barker	19820811	31.73	0.00	1.04	0%	0.00	6.5%	2.14
Summit County (Upper Division)			**32**				**0**		**2**
23-3463	Dean	19770210	110.30	80.00	1.20	77%	101.92	9.3%	12.31
23-3519	Dean	19780621		10.00	1.20	9%	11.91	9.3%	0.00
23-3589	Schultess	19810106	363.10	15.00	1.20	4%	17.43	9.3%	40.52
23-3472	Schultess	19770513		56.00	1.20	14%	10.67	9.3%	0.00
23-3473	Muir	19770513	93.80		1.20	53%	59.66	9.3%	10.47
23-3486	Argyle	19770706	203.79	153.25	1.20	13%	31.79	9.3%	22.74
23-3518	Tingey	19780621	172.60	90.00	1.20	52%	107.70	9.3%	19.26
23-3691	Gray	19870319	7.60	1.20	1.20	16%	1.46	9.3%	0.85
Rich County (Upper Division)			**951**				**343**		**106**
Upper Division Totals			**983**				**343**		**108**
23-3576	Nebeker	19800822	266.00	26.03	1.01	6%	16.12	8.2%	2.16
23-3591	Johnson	19810120	21.60	20.00	1.01	38%	8.29	8.2%	1.66
23-3666	Falula Farms	19840210	262.00	60.00	1.01	23%	60.86	8.2%	4.97
Rich County (Lower Division)			**550**				**85**		**9**
25-6688	Hansen	19751022	31.00		1.00	0%	0.00	4.2%	1.30
25-6829	Cal Funk	19760304	56.60	20.00	1.00	35%	20.00	4.2%	2.38
25-6952	Spackman	19760528	9.56	5.00	1.00	0%	0.00	4.2%	0.40
25-7151	USU Skeen	19770129	96.00	15.00	1.00	47%	45.00	4.2%	4.03
25-7159	Dorius	19770117	30.40	26.00	1.00	86%	26.14	4.2%	1.28
25-7162	Dorius	19770202	91.92	75.00	1.00	25%	22.98	4.2%	3.86
25-7196	Johnson, etal	19770311	58.20	20.00	1.00	16%	9.31	4.2%	2.44
25-7307	Chambers	19770314	65.60	25.00	1.00	0%	0.00	4.2%	2.76
25-7312	Harris	19770316	231.80	30.00	1.00	15%	34.77	4.2%	9.74
25-7329	Benson	19770331	46.50	18.00	1.00	7%	3.26	4.2%	1.95
25-7330	Thalman	19770404	29.20		1.00	30%	8.76	4.2%	1.23
25-7337	Jones	19770404	12.00	9.00	1.00	0%	0.00	4.2%	0.50
25-7380	Jones	19770504	47.12	30.00	1.00	0%	0.00	4.2%	1.98
25-7387	Gittens	19770512	28.90	20.00	1.00	69%	20.00	4.2%	1.21
25-7393	Waite	19770505	28.90	8.00	1.00	28%	8.00	4.2%	1.21
25-7412	Poppleton	19770521	14.20		1.00	0%	0.00	4.2%	0.60
25-7415	Riley Smith Irr	19770526	119.10	30.00	1.00	25%	29.78	4.2%	5.00

2009 Supplemental Depletion Estimate

Water Right #	Name	Priority (Y-M-D)	Acres	Sole supply acres	Depletion af/ac	"Supply" Depl. Factor	Depletion (acre-feet)	Old Supplemental Shortage Methodolgy (for compairson purposes only) "Shortage" Depl. Factor	Depletion (acre-feet)
25-7416	Swenson	19770527	24.00		1.00	0%	0.00	4.2%	1.01
25-7425	Jones	19770609	20.60	20.00	1.00	0%	0.00	4.2%	0.87
25-7430	Humphreys	19770610	11.20	5.00	1.00	10%	1.12	4.2%	0.47
25-7446	5 hills	19770711	97.05	23.25	1.00	0%	0.00	4.2%	4.08
25-7469	Karren	19770803	65.00	40.00	1.00	15%	9.75	4.2%	2.73
25-7482	Chambers	19770801	51.30	15.00	1.00	0%	0.00	4.2%	2.15
25-7556	Graham	19771122	8.20		1.00	11%	0.90	4.2%	0.34
25-7563	Buttars	19771209	84.70	9.80	1.00	12%	10.16	4.2%	3.56
25-7564	Lindley	19771213	132.98	90.00	1.00	68%	90.43	4.2%	5.59
25-7569	Webb	19771222	82.00	40.00	1.00	25%	20.50	4.2%	3.44
25-7575	Wheeler	19780110	65.10	6.00	1.00	10%	6.51	4.2%	2.73
25-7577	Nielsen	19780113	24.30	4.00	1.00	10%	2.43	4.2%	1.02
25-7579	Pitcher Farms	19780118	171.10	38.00	1.00	0%	0.00	4.2%	7.19
25-7654	Gibbons	19780615	6.30	3.30	1.00	52%	3.28	4.2%	0.26
25-7658	Coveville Irr	19780619	677.65	24.00	1.00	0%	0.00	4.2%	28.46
25-7688	Art Smith	19781006	9.30		1.00	0%	0.00	4.2%	0.39
25-7699	Weston	19780828	6.00	3.00	1.00	0%	0.00	4.2%	0.25
25-7706	Jack Ryan	19780905	6.30	0.40	1.00	50%	3.15	4.2%	0.26
25-7866	Skidmore	19781121	623.00	300.00	1.00	15%	93.45	4.2%	8.40
25-7888	Buttars	19790110	87.30	26.90	1.00	15%	13.10	4.2%	3.67
25-7927	Richmond Irr	19790411	1212.00	5.00	1.00	1%	6.06	4.2%	50.90
25-8010	Buxton	19790608	145.30	5.00	1.00	3%	4.36	4.2%	6.10
25-8013	Burnett	19790614	14.40		1.00	7%	1.01	4.2%	0.60
25-8015	Dorius	19790613	8.70	6.00	1.00	25%	2.18	4.2%	0.37
25-8028	Reese	19790709	41.60	38.00	1.00	30%	12.48	4.2%	1.75
25-8044	Baer	19790809	5.70	5.00	1.00	75%	4.28	4.2%	0.24
25-8062	Spackman	19790924	39.40	10.00	1.00	0%	0.00	4.2%	1.65
25-8077	James	19791026	16.62	2.00	1.00	12%	1.99	4.2%	0.70
25-8098	Skidmore	19800125	46.80	3.50	1.00	8%	3.51	4.2%	0.42
25-8113	Lee	19791026	8.63	1.10	1.00	0%	0.00	4.2%	0.36
25-8114	Waite	19791026	26.96	3.25	1.00	6%	1.62	4.2%	1.13
25-8151	Wennergren	19800414	94.00	60.00	1.00	0%	0.00	4.2%	3.95
25-8154	Bentley	19800421	64.90	35.00	1.00	15%	9.74	4.2%	2.73
25-8174	Adams	19800703	9.60	4.00	1.00	42%	4.03	4.2%	0.40
25-8187	Campbell	19800813	4.25		1.00	0%	0.00	4.2%	0.18
25-8191	Johnson, etal	19800828	8.75		1.00	12%	1.05	4.2%	0.37
25-8228	LDS Nibley	19810128	2.80		1.00	100%	2.80	4.2%	0.12
25-8237	Kimball	19810219	15.90		1.00	0%	0.00	4.2%	0.67
25-8249	Wilson	19810302	12.90		1.00	0%	0.00	4.2%	0.54

2009 Supplemental Depletion Estimate								Old Supplemental Shortage Methodolgy (for compairson purposes only)	
Water Right #	Name	Priority (Y-M-D)	Acres	Sole supply acres	Depletion af/ac	"Supply" Depl. Factor	Depletion (acre-feet)	"Shortage" Depl. Factor	Depletion (acre-feet)
25-8263	Munk	19810324	378.70	223.30	1.00	50%	189.35	4.2%	15.91
25-8268	Seamons	19810409	150.40	75.40	1.00	28%	42.11	4.2%	6.32
25-8272	B Lindley	19810414	363.20	55.00	1.00	8%	29.06	4.2%	15.25
25-8275	Gilbert Farm	19810420	58.90	2.00	1.00	2%	1.18	4.2%	2.47
25-8281	Burnett	19810504	35.70	30.00	1.00	0%	0.00	4.2%	1.50
25-8286	Richmond Irr	19810514	485.70	10.50	1.00	2%	9.71	4.2%	20.40
25-8297	Benson	19810623	52.20	40.00	1.00	7%	3.65	4.2%	2.19
25-8311	Spackman	19810727	128.10	31.50	1.00	59%	75.58	4.2%	5.38
25-8348	James	19801118	31.20	4.00	1.00	13%	4.06	4.2%	1.31
25-8385	WDCI	19820608	513.20	210.00	1.00	41%	210.41	4.2%	21.55
25-8396	Hardman	19820726	319.20	317.90	1.00	25%	79.80	4.2%	13.41
25-8397	Munk	19820726	158.90	68.10	1.00	18%	28.60	4.2%	6.67
25-8446	Ashby	19820902	13.20		1.00	30%	3.96	4.2%	0.55
25-8505	Bingham	19830602	33.10		1.00	0%	0.00	4.2%	1.39
25-8512	Harris	19830711	10.00	8.00	1.00	25%	2.50	4.2%	0.42
25-8583	Skabelund	19840608	44.50	5.00	1.00	11%	4.90	4.2%	1.87
25-8636	Bliesner	19840917	6.30		1.00	15%	0.95	4.2%	0.26
25-8668	Muir	19850418	5.00		1.00	0%	0.00	4.2%	0.21
25-8685	Logan	19850621	27.80	14.00	1.00	50%	13.90	4.2%	1.17
25-8714	Humphreys	19860123	5.90		1.00	10%	0.59	4.2%	0.25
25-8724	Wheeler	19860311	138.40		1.00	37%	51.21	4.2%	5.81
25-8814	Serrano	19870323	9.00		1.00	0%	0.00	4.2%	0.38
25-8853	Buttars	19870619	87.30		1.00	16%	13.97	4.2%	3.67
25-8860	Nielsen	19870817	35.20	10.00	1.00	0%	0.00	4.2%	1.48
25-8869	Shill	19870903	3.00		1.00	32%	0.96	4.2%	0.13
25-8872	Hyclone	19871002	6.18	2.56	1.00	50%	3.09	4.2%	0.26
25-8894	Shupe	19880329	68.00	53.00	1.00	0%	0.00	4.2%	2.86
25-8908	Beckstrom	19880607	11.14	5.00	1.00	10%	1.11	4.2%	0.47
25-8927	Kyriopoulos	19880823	20.32	13.42	1.00	66%	13.41	4.2%	0.85
25-8938	Parker	19881013	40.00		1.00	0%	0.00	4.2%	1.68
25-8944	Smithfield	19881031	69.20		1.00	58%	40.14	4.2%	2.91
25-8948	Allsop	19881220	122.00	15.20	1.00	12%	14.64	4.2%	5.12
25-8949	Archibald	19881221	74.83		1.00	26%	19.46	4.2%	3.14
25-8977	Jensen	19890328	3.00		1.00	0%	0.00	4.2%	0.13
25-8991	Rigby	19890524	160.30	130.00	1.00	81%	129.84	4.2%	6.73
25-9012	R&J Farms	19891016	308.40	70.00	1.00	23%	70.93	4.2%	12.95
25-9014	Ballard	19891020	270.90		1.00	90%	243.81	4.2%	11.38
25-9778	Ballard	19961025	29.10		1.00	90%	26.19	4.2%	1.22
Cache County (Lower Division)			**9307**				**1952**		**372**

2009 Supplemental Depletion Estimate

Water Right #	Name	Priority (Y-M-D)	Acres	Sole supply acres	Depletion af/ac	"Supply" Depl. Factor	Depletion (acre-feet)	Old Supplemental Shortage Methodolgy (for compairson purposes only) "Shortage" Depl. Factor	Old Supplemental Shortage Methodolgy (for compairson purposes only) Depletion (acre-feet)
29-2220	Washakie	19770818	811.18	25.00	1.09	3%	26.53	4.5%	4.20
29-2298	Tabbs	19780830	5.00		1.09	0%	0.00	4.5%	0.25
29-2344	Godfrey	19790525	44.99	15.00	1.09	33%	16.18	4.5%	2.21
29-2388	3M Farms	19800103	100.30	53.00	1.09	0%	0.00	4.5%	4.92
29-2731	Richards	19810515	2.02	0.97	1.09	19%	0.42	4.5%	0.10
29-2766	Lazy B	19810928	78.10	54.00	1.09	70%	59.59	4.5%	3.83
29-2781	Roylance	19820226	35.30	15.30	1.09	43%	16.55	4.5%	1.73
29-2815	Flying Mule Shoe	19821130	26.26	21.60	1.09	82%	23.47	4.5%	1.29
29-2979	Tuleview	19831201	5.80	1.40	1.09	0%	0.00	4.5%	0.28
29-3002	Richards	19840531	32.33	25.05	1.09	81%	28.54	4.5%	1.59
29-3819	Denton John	19950925	96.06	80.00	1.09	83%	86.91	4.5%	4.71
29-3847	Roderick	19960905	65.70	37.20	1.09	57%	40.82	4.5%	3.22
29-4142	Zollinger	20020521	34.48	17.48	1.09	51%	19.17	4.5%	1.69
29-4295	Steed	20060206	40.00		1.09	0%	0.00	4.5%	2.92
Tremonton Sub. (Lower Division)			**1378**				**318**		**33**
29-2165	Ferry	19770401	80.75	20.00	1.16	25%	23.42	14.0%	13.11
29-2166	Ferry	19770401	172.60	91.60	1.16	53%	106.11	14.0%	28.03
29-2521	McMurdie	19800626	96.27	21.27	1.16	22%	24.57	14.0%	15.63
29-2532	Ferry	19800825	70.67		1.16	20%	16.40	14.0%	11.48
29-3550	Carter	19890706	89.30	58.80	1.16	66%	68.37	14.0%	14.50
29-3559	Walker	19890919	22.80		1.16	0%	0.00	14.0%	3.70
29-3582	Norman	19900321	150.00		1.16	25%	43.50	14.0%	24.36
29-3849	Christensen	19960917	60.00	17.20	1.16	29%	20.18	14.0%	9.74
29-4176	Clark	20021203	67.24	49.89	1.16	75%	58.50	14.0%	10.92
Brigham City Sub. (Lower Division)			**810**				**361**		**131**
Box Elder County (Lower Division)			**2187**				**679**		**164**
Lower Division Totals			**12044**				**2717**		**545**

Notes:

Sole Supply acres are limitations on the water right determined at the time of the filing or the proof.
Depletion value (af/ac) are the Et values adopted by the Commission.
"Supply" Depletion factors were derived on a case-by-case basis using sole supply values and/or information from water users.
Depletion = Acres x Depletion x "Supply" Depl. Factor. These values are reported above.

Shortage Depletion factors are from Appendix C of the Commission Approved Procedures used in the 1992 report.
Depletion = Acres x Depletion x "Shortage" Depl. Factor. These are shown for comparison of 1992 report methodology.

Change in Depletion for Industrial Use in Utah

Self-supplied Industry	1976 Depletion	2010			Change in Depletion
		Diversion	C.U. factor	Depletion	
Cache County		(AF)		(AF)	(AF)
Casper's Ice Cream		48.7	0.15	7.3	
Gossner Foods, Inc		581.6	0.15	87.2	
Zollinger Warehouse		6.00	0.20	1.2	
Pepperidge Farms, Inc.		66.7	0.12	8.0	
JB Swift & Co.		1287.8	0.05	64.4	
Cache County Total	85			168	83
Box Elder County					
Nucor Steel Corp.		345.0	1.00	345	
Box Elder County Total	140			345	205

Notes
1976 Depletion and Consumptive Use (C.U.) factors as used in the 1992 report.
2010 Consumpive Use factors for Nucor Steel reflects total use or containment.

WOODRUFF NARROWS RESERVOIR SIMULATION RESULTS

February 2013

Updated Simulation Results to the 1981 Woodruff Narrows Reservoir Operation Simulation Program with Hydropower User's Manual.

The original Woodruff Narrows Reservoir was constructed in 1961 to provide supplemental irrigation water for approximately 40,000 acres of meadow hay in Upper Bear River Valley in Utah and Wyoming. The total storage capacity of the reservoir was 28,100 acre-feet, of which 22,500 acre-feet was used for irrigation, 4,000 acre-feet was used for fish conservation for maintaining a minimum flow release from the reservoir of 10 cfs to the main stem of the Bear River during the non-irrigation season, and 1,600 acre-feet was dead storage used for fish conservation in the reservoir. Of the 22,500 acre-feet of storage for irrigation, 18,240 acre-feet was generally used as active storage each year and 4,260 acre-feet was reserved for hold-over storage for use in drought years. Eighty-three (83) percent of the storage water is allocated to Utah water users and seventeen (17) percent is allocated to Wyoming users.

The irrigation season generally begins the first of May. Flows below the reservoir from spill and/or releases ranging from 500 cfs to 700 cfs are required to maintain the irrigation canals to their capacity depending upon tributary inflow and irrigation return flows. Irrigation of the meadow hay generally continues until approximately the l0th of July, when the flow from the reservoir is reduced to approximately 25 cfs for stockwatering and fishery purposes. The reservoir releases remain low until approximately the 20th of August when releases of 600 to 700 cfs are made for 5 to 10 days to provide for additional irrigation on the meadow hay and pasture to increase production for fall grazing. If

sufficient water is not remaining in the reservoir above the hold-over storage for at least 5 days of irrigation, no late storage releases are made.

An updated computer run simulating the original Woodruff Narrows Reservoir operation under normal operating conditions for the 1941-2012 period of stream flow records available at the reservoir site is shown in Appendix A. A 50% irrigation efficiency was assumed for the simulation, with 50% of the return flow occurring in the diverting month, 30% in the 2nd month and the remaining 20% in the 3rd month. The updated simulation shows that the late season water (QX(5) for August irrigation) is available only about 51 percent of the time (37 of the 72 years). The average irrigation shortage is 15,719 acre-feet (16%), with a maximum shortage of 74,025 acre-feet (74%) in 1977.

The enlarged Woodruff Narrows Reservoir increases the original capacity by 29,200 acre-feet to a total capacity of 57,300 acre-feet. It is estimated that of the 29,200 acre-feet of new storage, approximately 7,500 acre-feet would be used as hold-over storage. Based on 83% and 17% use respectively for Utah and Wyoming, this would result in 18,000 acre-feet of new active storage for Utah and 3,700 acre-feet of new active storage for Wyoming. This provides a total active storage of 39,940 acre-feet and a hold-over storage of 11,760 acre-feet. The hold-over storage, when combined with the fish conservation storage and dead storage, amounts to 17,360 acre-feet.

In addition to the enlarged capacity of the reservoir, the Woodruff Narrows Reservoir Companies plan to sell approximately 3,000 acre-feet of water for industrial use. A simulation run of the enlarged reservoir using the same criteria for irrigation as the original Woodruff Narrows simulation and a continuous demand for 3,000 acre-feet of industrial water with no return

flow is shown in Appendix B. The updated simulation shows that the late season water (QX(5) for August irrigation) was available only about 64 percent of the time (46 of the 72 years). The average irrigation shortage would be 9,449 acre-feet (9%) with a maximum shortage of 67,517 acre-feet (66% in 1961, with no shortage for the industrial water. The difference in QX(5) between the "old" and "enlarged" simulations shows an average yield increase of 9,270 acre-feet. The simulations show an increase of 1,013 acre-feet of evaporation from the reservoir surface from the pre and post enlargement (based on the 83% and 17% allocations for Utah and Wyoming respectively. The depletions for just the reservoir evaporation would be 841 acre-feet and 172 acre-feet).

The total depletion from the Bear River System, including evaporation, is the difference in QX(8) between the pre and post simulations, which is 7,148 acre-feet. Based on the 83% and 17% allocations for Utah and Wyoming respectively, the total depletions would be 5,933 acre-feet and 1,215 acre-feet.

It should be noted that the results of these simulations are not necessarily the view or opinions of the Utah Division of Water Resources, the Utah State Engineer, the Wyoming State Engineer, or the Woodruff Narrows Reservoir Companies. The simulation is provided as a tool which may be used in determining water allocations and potential reservoir operating criteria. A schematic of the Woodruff Narrows Reservoir model is shown in Figure 1.

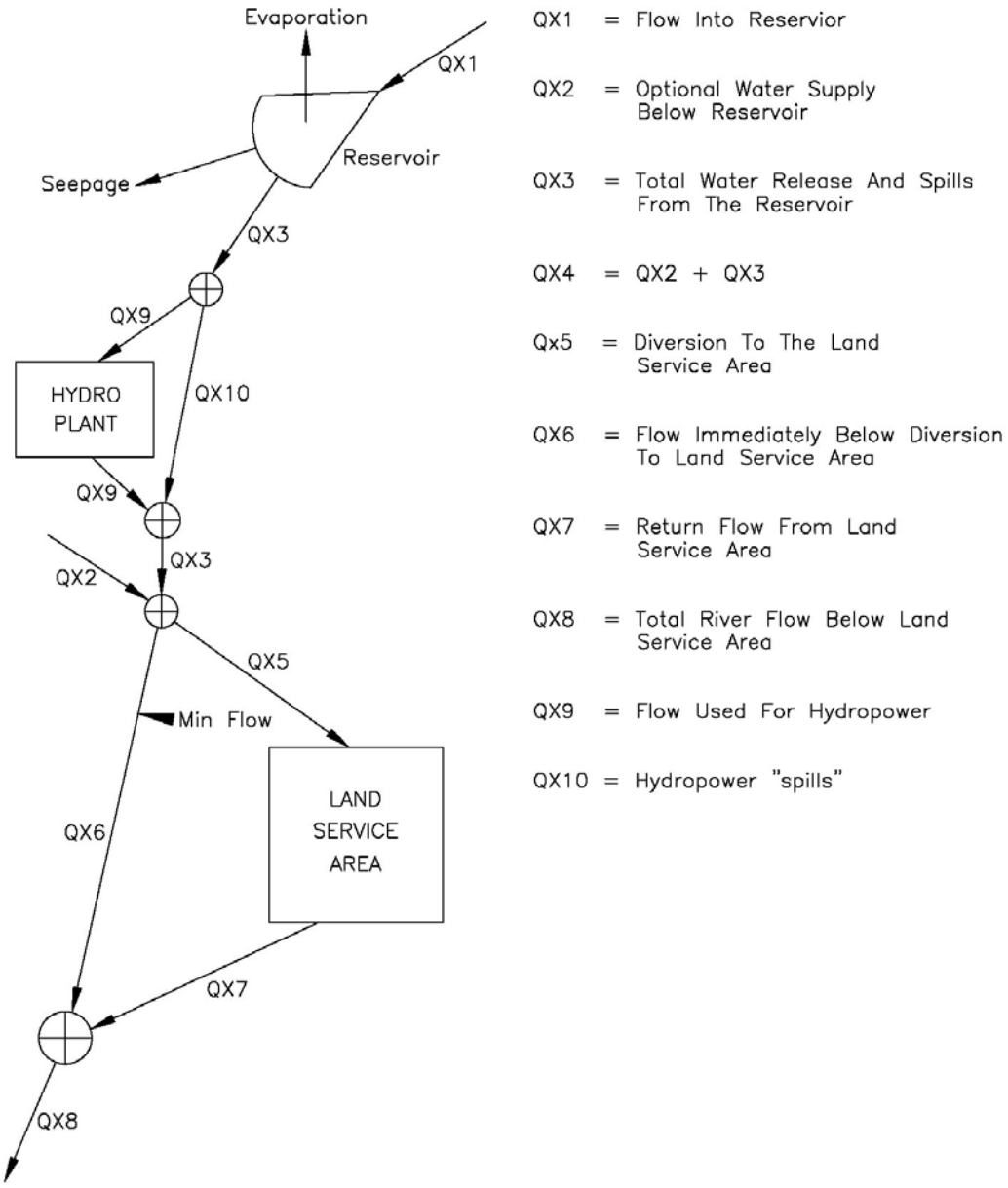


Figure 1. Woodruff Narrows Reservoir Simulation and Notation.

APPENDIX A

Simulation Output Results
for the
Old Woodruff Narrows Reservoir

RESERVOIR SIMULATION INPUT DATA

10:20:32

DATA FILE: WNOLD.DAT

RESERVOIR PARAMETERS

```
 OLD WOODRUFF NARROWS RESERVOIR
NP,SMX ...        15    28100.     5018.    10000.         0         0
EVRT WY       0.07    0.01    0.00    0.00    0.00    0.02    0.07    0.18    0.32    0.48    0.39    0.22      1.76
QRMN WY       600.    600.    600.    600.    600.    600.    600.    600.    600.    600.    600.    600.     7200.
QSM WY          0.      0.      0.      0.      0.      0.      0.      0.      0.      0.      0.      0.        0.

ELEVATION-AREA-CAPACITY TABLE
     6400.0     6404.0     6410.0     6411.7     6415.0     6420.0     6425.0     6430.0     6435.0     6439.4
     6445.0     6450.0     6452.5     6454.5     6460.0
        0.0        9.0      312.0      417.0      513.0      714.0      906.0     1114.0     1380.0     1620.0
     1796.0     2086.0     2112.0     2312.0     2590.0
        0.0       18.0      980.0     1600.0     3135.0     6195.0    10245.0    15295.0    21530.0    28100.0
    37700.0    47405.0    52777.0    57300.0    70780.0
```

LAND USE PARAMETERS

```
 WOODRUFF-RANDOLPH AREA         ACRES =  40000.     EFF =0.500     RFF =1.000
AREAF =     1.000     EFMI =     1.000     QDMIY =        0.
CUN WY        0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.45    0.50    0.15    0.15    0.00    1.25
QMIP        0.0830  0.0830  0.0830  0.0830  0.0830  0.0830  0.0830  0.0830  0.0840  0.0840  0.0840  0.0840  1.0000
RTFLO FACT    0.50    0.30    0.20    0.00    0.00    0.00    0.00    0.00    0.00    0.00


NYRS,INYR,NRES,NLND,NQIN,NHPW,NFDT,IPQN,IPSH,IPST,IPEV,IPEL,IPSA,IPAS,IOFF,IQMN,IANPLT,IMNPLT,IQMNL,IDISK,IQIFLV,IPQIN
 72  1941   1    1    1    0    0    F    T    T    T    T    T    T    F    F     F      F     F     F      T     F

QX6MN       0.      0.      0.      0.      0.      0.      0.      0.      0.      0.      0.      0.

QIN    FILE
  1  10020100.C

Woodruff Narrows Variables SF(I)
    18240.00    15860.00     6000.00     4260.00     1600.00        0.00        0.00        0.00

ELAPSED TIME:  0: 0: 0.00

ELAPSED TIME:  0: 0: 0.00
```

DIVERSION REQUIREMENTS

USE	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	ANN
LAND AREA 1	WOODRUFF-RANDOLPH AREA												
QDMI	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
QDIR	0.	0.	0.	0.	0.	0.	0.	36000.	40000.	12000.	12000.	0.	100000.
TOTAL	0.	0.	0.	0.	0.	0.	0.	36000.	40000.	12000.	12000.	0.	100000.

QX(1) Discharge (ac-ft): Bear River above Woodruff Narrows Reservoir

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	ANN
1941	499.	859.	1580.	1455.	1077.	5987.	9928.	24447.	35096.	2186.	644.	650.	84408.
1942	5160.	5060.	4610.	3690.	3890.	7380.	36450.	41590.	42390.	1920.	80.	0.	152220.
1943	50.	890.	1860.	2090.	3450.	10790.	30370.	40100.	37440.	5410.	1000.	60.	133510.
1944	800.	1840.	2350.	2550.	2690.	2690.	31130.	64260.	59390.	12150.	70.	0.	179920.
1945	340.	1120.	1620.	2720.	2890.	7910.	21700.	37470.	36480.	10140.	7950.	2220.	132560.
1946	3490.	5790.	5320.	4920.	3690.	10770.	37460.	41500.	22380.	450.	30.	0.	135800.
1947	1030.	4340.	5360.	4060.	3940.	24260.	14460.	58950.	54110.	11040.	2880.	1200.	185630.
1948	2680.	4460.	5040.	5160.	4600.	6350.	35100.	58890.	26510.	370.	10.	0.	149170.
1949	120.	1510.	3750.	3840.	3330.	6020.	31760.	44900.	44310.	8650.	130.	90.	148410.
1950	1800.	2860.	3460.	3300.	3920.	8140.	45020.	67380.	86210.	15600.	2470.	1590.	241750.
1951	3180.	4810.	5050.	4390.	4600.	8530.	37780.	48840.	50260.	10740.	7000.	2040.	187220.
1952	7450.	4850.	5710.	6010.	5950.	6210.	58710.	106200.	71760.	12190.	6090.	2220.	293350.
1953	2270.	2240.	4100.	5610.	4080.	6350.	13040.	20540.	62090.	3590.	900.	40.	124850.
1954	190.	1360.	3670.	4000.	3870.	4960.	12520.	24520.	5380.	650.	40.	0.	61160.
1955	60.	420.	1800.	2640.	2400.	1580.	9510.	28740.	20530.	420.	140.	0.	68240.
1956	210.	2010.	7800.	5980.	4830.	14500.	14880.	57090.	37330.	1310.	60.	0.	146000.
1957	10.	1360.	2750.	2520.	2910.	5080.	16780.	42800.	97960.	23260.	1530.	670.	197630.
1958	1930.	3930.	4200.	3740.	4220.	5800.	12110.	47760.	20150.	700.	10.	0.	104550.
1959	70.	230.	530.	1660.	2280.	4680.	10390.	20480.	39010.	6100.	400.	830.	86660.
1960	3620.	4740.	2010.	2380.	2830.	18010.	12920.	24280.	23150.	230.	90.	10.	94270.
1961	310.	840.	2130.	2120.	2060.	1480.	3150.	13680.	8830.	70.	280.	1410.	36360.
1962	800.	1320.	3410.	2990.	11860.	7290.	38510.	41420.	45780.	8210.	610.	240.	162440.
1963	712.	1766.	2898.	1299.	6139.	2253.	8019.	30113.	31083.	748.	178.	280.	85488.
1964	440.	1860.	2680.	2460.	2010.	2480.	17050.	58700.	60870.	10710.	260.	200.	159720.
1965	190.	890.	5270.	6120.	4990.	5130.	30780.	58810.	102610.	41390.	14690.	12380.	283250.
1966	12130.	7270.	6330.	5620.	4140.	16570.	24710.	42370.	7510.	560.	340.	530.	128080.
1967	1340.	3260.	5570.	4700.	4010.	10660.	12280.	45340.	79420.	29520.	1990.	850.	198940.
1968	5540.	4430.	4260.	4000.	5500.	8280.	15910.	42090.	86510.	9460.	7720.	4450.	198150.
1969	6940.	6520.	6190.	6240.	4770.	7110.	39910.	54950.	26050.	3790.	850.	680.	164000.
1970	3020.	3210.	3560.	4290.	4280.	4240.	13860.	51860.	50970.	3750.	1100.	1780.	145920.
1971	4930.	5190.	7530.	8710.	9200.	17310.	26350.	56730.	72840.	11720.	630.	2130.	223270.
1972	5890.	7190.	6810.	5760.	6250.	29050.	26980.	63340.	71270.	2950.	380.	670.	226540.
1973	4880.	5450.	4610.	5040.	5000.	8090.	24390.	76610.	36930.	9570.	2340.	7520.	190430.
1974	9200.	11790.	7980.	6590.	5920.	16080.	32280.	90870.	58590.	6020.	740.	870.	246930.
1975	1280.	2440.	3710.	3810.	3250.	5150.	10540.	40940.	80660.	53500.	4150.	2460.	211890.
1976	4010.	6620.	6190.	4850.	4750.	14060.	24730.	45910.	17620.	1750.	590.	350.	131430.
1977	863.	1049.	964.	1012.	1349.	1648.	4623.	6415.	11336.	2360.	599.	427.	32645.
1978	920.	550.	660.	1210.	1110.	10050.	14830.	38410.	64100.	7450.	950.	1780.	142020.
1979	1609.	1533.	2291.	2618.	2628.	5161.	11683.	26924.	14551.	988.	855.	176.	71017.
1980	840.	1210.	1370.	3110.	3130.	5930.	39470.	61460.	49000.	10330.	640.	790.	177280.
1981	1900.	3290.	3520.	3300.	3430.	3600.	24560.	42850.	42660.	1350.	210.	540.	131210.
1982	3980.	1330.	2970.	3260.	3770.	9590.	22790.	63190.	56130.	28340.	6170.	14080.	215600.
1983	26880.	11120.	5850.	6230.	5650.	13250.	22100.	64220.	147030.	37230.	20890.	17150.	377600.
1984	14520.	10920.	11130.	9040.	7320.	10930.	32020.	120340.	87520.	23960.	12690.	14110.	354500.
1985	15240.	10640.	9630.	8400.	7510.	8000.	21600.	54710.	27180.	4780.	1960.	2670.	172320.
1986	6100.	6130.	6580.	6200.	17310.	38560.	37230.	115080.	152550.	24370.	6850.	5410.	422370.
1987	9730.	7770.	6980.	5170.	5850.	11030.	22190.	44040.	14870.	2550.	3320.	2500.	136000.
1988	1780.	2680.	2000.	1830.	1490.	6380.	17120.	35730.	10900.	300.	140.	30.	80380.
1989	355.	361.	443.	416.	843.	11472.	13321.	18238.	20067.	2688.	1557.	1315.	71076.
1990	1377.	2134.	2269.	2410.	2225.	5078.	7232.	11659.	26783.	3368.	1526.	1244.	67305.
1991	1260.	1810.	1550.	1900.	1680.	2190.	5830.	33770.	41400.	2880.	2360.	2170.	98800.
1992	1418.	5883.	4046.	3971.	4183.	11560.	9297.	24085.	3247.	1086.	163.	169.	69108.
1993	460.	790.	990.	790.	770.	8830.	18340.	81950.	54290.	16180.	5670.	2390.	191450.
1994	5650.	3360.	3710.	3720.	3110.	9450.	13390.	32370.	8950.	350.	160.	80.	84300.
1995	1930.	980.	3220.	3490.	4710.	12150.	5170.	24070.	111490.	73230.	5390.	1770.	247600.
1996	4930.	5080.	4510.	3530.	4240.	10560.	25440.	55060.	49750.	4540.	490.	990.	169120.
1997	1420.	3410.	5890.	6260.	6690.	13560.	32420.	63050.	64380.	3160.	3250.	4910.	208400.
1998	7730.	10350.	6820.	6190.	5230.	17640.	22330.	51110.	73320.	38880.	8160.	3830.	251590.
1999	5690.	7770.	6920.	5390.	4940.	14820.	20610.	61790.	69670.	8780.	3380.	3080.	212840.
2000	3955.	3683.	5211.	5546.	5669.	8541.	10871.	30004.	7468.	272.	41.	967.	82228.
2001	1410.	2940.	2000.	1830.	2310.	7600.	9810.	36310.	5940.	1560.	40.	80.	71830.
2002	218.	419.	2008.	2321.	2660.	4786.	6835.	15447.	8632.	476.	52.	116.	43970.
2003	250.	2200.	1680.	560.	580.	4580.	6120.	32070.	23810.	2410.	2110.	1840.	78210.
2004	703.	870.	1640.	1745.	1573.	9007.	8475.	18966.	12329.	4205.	2698.	1480.	63691.
2005	2830.	4310.	2470.	3520.	3340.	5120.	12540.	62650.	48490.	8850.	3030.	1710.	158860.
2006	1640.	1760.	2500.	2790.	2800.	6030.	13830.	50280.	28270.	3140.	2910.	2480.	118430.
2007	5450.	5490.	3630.	3040.	2480.	10800.	12080.	38360.	7570.	2440.	1110.	1690.	94140.
2008	2450.	1610.	2190.	2150.	2020.	2370.	8090.	46710.	59960.	8000.	1730.	2390.	139670.
2009	1600.	1420.	1410.	2020.	2120.	5930.	16930.	62100.	51200.	8770.	1790.	2230.	157520.
2010	1820.	1800.	1390.	1600.	2070.	2850.	15480.	28150.	78340.	5110.	1880.	1440.	141930.
2011	1500.	1190.	4300.	5300.	4290.	7630.	39950.	77820.	133630.	83330.	7500.	3520.	369960.
2012	6419.	6365.	4473.	4842.	4074.	16358.	13898.	15142.	2822.	1484.	1204.	1484.	78565.
MEAN	3381.	3596.	3902.	3806.	4038.	9087.	20277.	46653.	46932.	10417.	2526.	2104.	156718.

QX(3) Discharge (ac-ft): Outflow from Woodruff Narrows Reservoir

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	ANN
1941	600.	600.	600.	600.	600.	600.	600.	36000.	40000.	6653.	600.	600.	88053.
1942	600.	600.	600.	600.	1718.	7351.	36350.	41332.	41932.	12000.	600.	600.	144283.
1943	600.	600.	600.	600.	600.	600.	28082.	39808.	40000.	12000.	12000.	600.	136090.
1944	600.	600.	600.	600.	600.	600.	22060.	63997.	58922.	12000.	12000.	600.	173179.
1945	600.	600.	600.	600.	600.	600.	16334.	37178.	40000.	12000.	12000.	600.	121713.
1946	600.	600.	3467.	4920.	3690.	10738.	37347.	41208.	40000.	4965.	600.	600.	148734.
1947	600.	600.	600.	600.	600.	21681.	14363.	58700.	53666.	12000.	12000.	600.	176011.
1948	600.	600.	600.	600.	2215.	6318.	34987.	58598.	40000.	8933.	600.	600.	154650.
1949	600.	600.	600.	600.	600.	600.	28340.	44651.	43867.	12000.	12000.	600.	145057.
1950	600.	600.	600.	600.	600.	2166.	44920.	67122.	85752.	14913.	12000.	600.	230474.
1951	600.	600.	600.	1043.	4600.	8498.	37667.	48548.	49742.	12000.	12000.	600.	176497.
1952	859.	4834.	5710.	6010.	5950.	6178.	58597.	105908.	71242.	12000.	12000.	600.	289887.
1953	600.	600.	1497.	5610.	4080.	6318.	12927.	36000.	46021.	12000.	12000.	600.	138252.
1954	600.	600.	600.	600.	600.	600.	8553.	36000.	13114.	600.	600.	600.	63067.
1955	600.	600.	600.	600.	600.	600.	600.	36000.	25083.	600.	600.	600.	67083.
1956	600.	600.	600.	600.	600.	14022.	14784.	56843.	40000.	12000.	600.	600.	141849.
1957	600.	600.	600.	600.	600.	600.	9417.	42538.	97494.	22561.	12000.	600.	188210.
1958	600.	600.	600.	600.	600.	5030.	11997.	47468.	40000.	3036.	600.	600.	111731.
1959	600.	600.	600.	600.	600.	600.	600.	34210.	38806.	5794.	600.	600.	84210.
1960	600.	600.	600.	600.	600.	12275.	12820.	36000.	28762.	600.	600.	600.	94657.
1961	600.	600.	600.	600.	600.	600.	600.	19166.	8626.	600.	600.	600.	33792.
1962	600.	600.	600.	600.	600.	6355.	38411.	41165.	45326.	12000.	12000.	600.	158857.
1963	600.	600.	600.	600.	600.	600.	1086.	36000.	40000.	3823.	600.	600.	85708.
1964	600.	600.	600.	600.	600.	600.	7008.	58448.	60421.	12000.	12000.	600.	154077.
1965	600.	600.	600.	600.	600.	1261.	30673.	58535.	102121.	40657.	14094.	12044.	262384.
1966	9507.	7254.	6330.	5620.	4140.	16538.	24597.	42078.	30074.	600.	600.	600.	147937.
1967	600.	600.	600.	600.	600.	8228.	12182.	45087.	78970.	28846.	12000.	600.	188913.
1968	600.	600.	600.	600.	4846.	8248.	15797.	41798.	85992.	12000.	12000.	600.	183680.
1969	2218.	6504.	6190.	6240.	4770.	7078.	39797.	54658.	40000.	11902.	600.	600.	180556.
1970	600.	600.	600.	600.	600.	1281.	13759.	51601.	50509.	12000.	600.	600.	133350.
1971	600.	600.	3543.	8710.	9200.	17278.	26237.	56438.	72322.	12000.	12000.	600.	219527.
1972	600.	628.	6810.	5760.	6250.	29018.	26867.	63048.	70752.	12000.	12000.	600.	234332.
1973	600.	600.	600.	600.	4281.	8060.	24286.	76343.	40000.	12000.	12000.	600.	179971.
1974	600.	6515.	7980.	6590.	5920.	16048.	32167.	90578.	58072.	12000.	12000.	600.	249069.
1975	600.	600.	600.	600.	600.	600.	8135.	40650.	80144.	52727.	12000.	600.	197856.
1976	600.	2784.	6190.	4850.	4750.	14028.	24617.	45618.	40000.	1622.	600.	600.	146258.
1977	600.	600.	600.	600.	600.	600.	600.	12789.	11132.	2054.	600.	600.	31375.
1978	600.	600.	600.	600.	600.	600.	7350.	38154.	63645.	12000.	12000.	600.	137349.
1979	600.	600.	600.	600.	600.	600.	5511.	36000.	25032.	682.	600.	600.	72026.
1980	600.	600.	600.	600.	600.	600.	33072.	61204.	48545.	12000.	12000.	600.	171020.
1981	600.	600.	600.	600.	600.	600.	21564.	42567.	42158.	12000.	600.	600.	123089.
1982	600.	600.	600.	600.	600.	7874.	22677.	62898.	55612.	27562.	12000.	7314.	198937.
1983	26767.	11104.	5850.	6230.	5650.	13218.	21987.	63928.	146512.	36452.	20258.	16794.	374749.
1984	14407.	10904.	11130.	9040.	7320.	10898.	31907.	120048.	87002.	23182.	12058.	13754.	351649.
1985	15127.	10624.	9630.	8400.	7510.	7968.	21487.	54418.	40000.	12000.	600.	600.	188363.
1986	600.	600.	600.	5013.	17310.	38528.	37117.	114788.	152032.	23592.	12000.	600.	402780.
1987	8338.	7754.	6980.	5170.	5850.	10998.	22077.	43748.	37434.	2244.	600.	600.	151793.
1988	600.	600.	600.	600.	600.	600.	11251.	36000.	32279.	600.	600.	600.	84930.
1989	600.	600.	600.	600.	600.	600.	5249.	34242.	19863.	2382.	600.	600.	66537.
1990	600.	600.	600.	600.	600.	600.	720.	30904.	26579.	3062.	600.	600.	66066.
1991	600.	600.	600.	600.	600.	600.	600.	36000.	40000.	12000.	600.	600.	93400.
1992	600.	600.	600.	600.	600.	9719.	9184.	36000.	13723.	780.	600.	600.	73605.
1993	600.	600.	600.	600.	600.	600.	9003.	81698.	53843.	15509.	12000.	600.	176253.
1994	600.	600.	600.	3127.	3110.	9418.	13277.	36000.	27638.	600.	600.	600.	96169.
1995	600.	600.	600.	600.	600.	5176.	5074.	36000.	99038.	72571.	12000.	600.	233459.
1996	600.	600.	600.	3234.	4240.	10528.	25327.	54768.	49232.	12000.	12000.	600.	173728.
1997	600.	600.	600.	600.	2965.	13529.	32311.	62770.	63883.	12000.	12000.	600.	202458.
1998	600.	943.	6820.	6190.	5230.	17608.	22217.	50818.	72802.	38102.	12000.	600.	233930.
1999	4018.	7754.	6920.	5390.	4940.	14788.	20497.	61498.	69152.	12000.	12000.	600.	219556.
2000	600.	600.	600.	5544.	5669.	8509.	10758.	36000.	23817.	600.	600.	600.	93897.
2001	600.	600.	600.	600.	600.	600.	5909.	36058.	22555.	1254.	600.	600.	70576.
2002	600.	600.	600.	600.	600.	600.	600.	28684.	8428.	600.	600.	600.	43112.
2003	600.	600.	600.	600.	600.	600.	600.	36000.	29220.	2104.	600.	600.	72725.
2004	600.	600.	600.	600.	600.	600.	2003.	36000.	15343.	3899.	600.	600.	62046.
2005	600.	600.	600.	600.	600.	600.	12093.	62373.	47998.	12000.	12000.	600.	150664.
2006	600.	600.	600.	600.	600.	600.	12741.	49988.	40000.	12000.	600.	600.	119530.
2007	600.	600.	600.	600.	600.	9856.	11967.	38068.	30134.	2134.	600.	600.	96359.
2008	600.	600.	600.	600.	600.	600.	600.	44737.	59484.	12000.	12000.	600.	133021.
2009	600.	600.	600.	600.	600.	600.	10114.	61808.	50682.	12000.	12000.	600.	150804.
2010	600.	600.	600.	600.	600.	600.	9807.	36000.	69778.	12000.	12000.	600.	143786.
2011	600.	600.	600.	600.	600.	3445.	39837.	77528.	133112.	82552.	12000.	600.	352074.
2012	3785.	6349.	4473.	4842.	4074.	16326.	13785.	36000.	4514.	1178.	600.	600.	96526.
MEAN	1706.	1658.	1849.	2057.	2332.	6411.	17617.	49664.	50693.	12849.	6603.	1260.	154699.

QX(5) Discharge (ac-ft): Diversions to Service Woodruff-Randolph Area

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	ANN
1941	0.	0.	0.	0.	0.	0.	0.	36000.	40000.	6653.	0.	0.	82653.
1942	0.	0.	0.	0.	0.	0.	0.	36000.	40000.	12000.	0.	0.	88000.
1943	0.	0.	0.	0.	0.	0.	0.	36000.	40000.	12000.	8955.	0.	96955.
1944	0.	0.	0.	0.	0.	0.	0.	36000.	40000.	12000.	12000.	0.	100000.
1945	0.	0.	0.	0.	0.	0.	0.	36000.	40000.	12000.	12000.	0.	100000.
1946	0.	0.	0.	0.	0.	0.	0.	36000.	40000.	4965.	0.	0.	80965.
1947	0.	0.	0.	0.	0.	0.	0.	36000.	40000.	12000.	12000.	0.	100000.
1948	0.	0.	0.	0.	0.	0.	0.	36000.	40000.	8933.	0.	0.	84933.
1949	0.	0.	0.	0.	0.	0.	0.	36000.	40000.	12000.	8054.	0.	96054.
1950	0.	0.	0.	0.	0.	0.	0.	36000.	40000.	12000.	12000.	0.	100000.
1951	0.	0.	0.	0.	0.	0.	0.	36000.	40000.	12000.	12000.	0.	100000.
1952	0.	0.	0.	0.	0.	0.	0.	36000.	40000.	12000.	12000.	0.	100000.
1953	0.	0.	0.	0.	0.	0.	0.	36000.	40000.	12000.	10040.	0.	98040.
1954	0.	0.	0.	0.	0.	0.	0.	36000.	13114.	600.	0.	0.	49714.
1955	0.	0.	0.	0.	0.	0.	0.	36000.	25083.	600.	0.	0.	61683.
1956	0.	0.	0.	0.	0.	0.	0.	36000.	40000.	12000.	0.	0.	88000.
1957	0.	0.	0.	0.	0.	0.	0.	36000.	40000.	12000.	12000.	0.	100000.
1958	0.	0.	0.	0.	0.	0.	0.	36000.	40000.	3036.	0.	0.	79036.
1959	0.	0.	0.	0.	0.	0.	0.	34210.	38806.	5794.	0.	0.	78810.
1960	0.	0.	0.	0.	0.	0.	0.	36000.	28762.	600.	0.	0.	65362.
1961	0.	0.	0.	0.	0.	0.	0.	19166.	8626.	600.	0.	0.	28392.
1962	0.	0.	0.	0.	0.	0.	0.	36000.	40000.	12000.	8946.	0.	96946.
1963	0.	0.	0.	0.	0.	0.	0.	36000.	40000.	3823.	0.	0.	79823.
1964	0.	0.	0.	0.	0.	0.	0.	36000.	40000.	12000.	10641.	0.	98641.
1965	0.	0.	0.	0.	0.	0.	0.	36000.	40000.	12000.	12000.	0.	100000.
1966	0.	0.	0.	0.	0.	0.	0.	36000.	30074.	600.	0.	0.	66674.
1967	0.	0.	0.	0.	0.	0.	0.	36000.	40000.	12000.	12000.	0.	100000.
1968	0.	0.	0.	0.	0.	0.	0.	36000.	40000.	12000.	12000.	0.	100000.
1969	0.	0.	0.	0.	0.	0.	0.	36000.	40000.	11902.	0.	0.	87902.
1970	0.	0.	0.	0.	0.	0.	0.	36000.	40000.	12000.	0.	0.	88000.
1971	0.	0.	0.	0.	0.	0.	0.	36000.	40000.	12000.	12000.	0.	100000.
1972	0.	0.	0.	0.	0.	0.	0.	36000.	40000.	12000.	8890.	0.	96890.
1973	0.	0.	0.	0.	0.	0.	0.	36000.	40000.	12000.	10288.	0.	98288.
1974	0.	0.	0.	0.	0.	0.	0.	36000.	40000.	12000.	12000.	0.	100000.
1975	0.	0.	0.	0.	0.	0.	0.	36000.	40000.	12000.	12000.	0.	100000.
1976	0.	0.	0.	0.	0.	0.	0.	36000.	40000.	1622.	0.	0.	77622.
1977	0.	0.	0.	0.	0.	0.	0.	12789.	11132.	2054.	0.	0.	25975.
1978	0.	0.	0.	0.	0.	0.	0.	36000.	40000.	12000.	8668.	0.	96668.
1979	0.	0.	0.	0.	0.	0.	0.	36000.	25032.	682.	0.	0.	61715.
1980	0.	0.	0.	0.	0.	0.	0.	36000.	40000.	12000.	11191.	0.	99191.
1981	0.	0.	0.	0.	0.	0.	0.	36000.	40000.	12000.	0.	0.	88000.
1982	0.	0.	0.	0.	0.	0.	0.	36000.	40000.	12000.	12000.	0.	100000.
1983	0.	0.	0.	0.	0.	0.	0.	36000.	40000.	12000.	12000.	0.	100000.
1984	0.	0.	0.	0.	0.	0.	0.	36000.	40000.	12000.	12000.	0.	100000.
1985	0.	0.	0.	0.	0.	0.	0.	36000.	40000.	12000.	0.	0.	88000.
1986	0.	0.	0.	0.	0.	0.	0.	36000.	40000.	12000.	12000.	0.	100000.
1987	0.	0.	0.	0.	0.	0.	0.	36000.	37434.	2244.	0.	0.	75678.
1988	0.	0.	0.	0.	0.	0.	0.	36000.	32279.	600.	0.	0.	68879.
1989	0.	0.	0.	0.	0.	0.	0.	34242.	19863.	2382.	0.	0.	56488.
1990	0.	0.	0.	0.	0.	0.	0.	30904.	26579.	3062.	0.	0.	60546.
1991	0.	0.	0.	0.	0.	0.	0.	36000.	40000.	12000.	0.	0.	88000.
1992	0.	0.	0.	0.	0.	0.	0.	36000.	13723.	780.	0.	0.	50503.
1993	0.	0.	0.	0.	0.	0.	0.	36000.	40000.	12000.	12000.	0.	100000.
1994	0.	0.	0.	0.	0.	0.	0.	36000.	27638.	600.	0.	0.	64238.
1995	0.	0.	0.	0.	0.	0.	0.	36000.	40000.	12000.	12000.	0.	100000.
1996	0.	0.	0.	0.	0.	0.	0.	36000.	40000.	12000.	10564.	0.	98564.
1997	0.	0.	0.	0.	0.	0.	0.	36000.	40000.	12000.	10226.	0.	98226.
1998	0.	0.	0.	0.	0.	0.	0.	36000.	40000.	12000.	12000.	0.	100000.
1999	0.	0.	0.	0.	0.	0.	0.	36000.	40000.	12000.	12000.	0.	100000.
2000	0.	0.	0.	0.	0.	0.	0.	36000.	23818.	600.	0.	0.	60418.
2001	0.	0.	0.	0.	0.	0.	0.	36000.	22555.	1254.	0.	0.	59809.
2002	0.	0.	0.	0.	0.	0.	0.	28684.	8428.	600.	0.	0.	37712.
2003	0.	0.	0.	0.	0.	0.	0.	36000.	29220.	2104.	0.	0.	67325.
2004	0.	0.	0.	0.	0.	0.	0.	36000.	15343.	3899.	0.	0.	55243.
2005	0.	0.	0.	0.	0.	0.	0.	36000.	40000.	12000.	12000.	0.	100000.
2006	0.	0.	0.	0.	0.	0.	0.	36000.	40000.	12000.	0.	0.	88000.
2007	0.	0.	0.	0.	0.	0.	0.	36000.	30134.	2134.	0.	0.	68268.
2008	0.	0.	0.	0.	0.	0.	0.	36000.	40000.	12000.	11695.	0.	99695.
2009	0.	0.	0.	0.	0.	0.	0.	36000.	40000.	12000.	12000.	0.	100000.
2010	0.	0.	0.	0.	0.	0.	0.	36000.	40000.	12000.	12000.	0.	100000.
2011	0.	0.	0.	0.	0.	0.	0.	36000.	40000.	12000.	12000.	0.	100000.
2012	0.	0.	0.	0.	0.	0.	0.	36000.	4514.	1178.	0.	0.	41693.
MEAN	0.	0.	0.	0.	0.	0.	0.	35222.	34891.	8360.	5808.	0.	84281.

QX(6) Discharge (ac-ft): Bear River Bypassing Diversions

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	ANN
1941	600.	600.	600.	600.	600.	600.	600.	0.	0.	0.	600.	600.	5400.
1942	600.	600.	600.	600.	1718.	7351.	36350.	5332.	1932.	0.	600.	600.	56283.
1943	600.	600.	600.	600.	600.	600.	28082.	3808.	0.	0.	3045.	600.	39135.
1944	600.	600.	600.	600.	600.	600.	22060.	27997.	18922.	0.	0.	600.	73179.
1945	600.	600.	600.	600.	600.	600.	16334.	1178.	0.	0.	0.	600.	21713.
1946	600.	600.	3467.	4920.	3690.	10738.	37347.	5208.	0.	0.	600.	600.	67769.
1947	600.	600.	600.	600.	600.	21681.	14363.	22700.	13666.	0.	0.	600.	76011.
1948	600.	600.	600.	600.	2215.	6318.	34987.	22598.	0.	0.	600.	600.	69718.
1949	600.	600.	600.	600.	600.	600.	28340.	8651.	3867.	0.	3946.	600.	49003.
1950	600.	600.	600.	600.	600.	2166.	44920.	31122.	45752.	2913.	0.	600.	130474.
1951	600.	600.	600.	1043.	4600.	8498.	37667.	12548.	9742.	0.	0.	600.	76497.
1952	859.	4834.	5710.	6010.	5950.	6178.	58597.	69908.	31242.	0.	0.	600.	189887.
1953	600.	600.	1497.	5610.	4080.	6318.	12927.	0.	6021.	0.	1960.	600.	40213.
1954	600.	600.	600.	600.	600.	600.	8553.	0.	0.	0.	600.	600.	13353.
1955	600.	600.	600.	600.	600.	600.	600.	0.	0.	0.	600.	600.	5400.
1956	600.	600.	600.	600.	600.	14022.	14784.	20843.	0.	0.	600.	600.	53849.
1957	600.	600.	600.	600.	600.	600.	9417.	6538.	57494.	10561.	0.	600.	88210.
1958	600.	600.	600.	600.	600.	5030.	11997.	11468.	0.	0.	600.	600.	32695.
1959	600.	600.	600.	600.	600.	600.	600.	0.	0.	0.	600.	600.	5400.
1960	600.	600.	600.	600.	600.	12275.	12820.	0.	0.	0.	600.	600.	29295.
1961	600.	600.	600.	600.	600.	600.	600.	0.	0.	0.	600.	600.	5400.
1962	600.	600.	600.	600.	600.	6355.	38411.	5165.	5326.	0.	3054.	600.	61911.
1963	600.	600.	600.	600.	600.	600.	1086.	0.	0.	0.	600.	600.	5886.
1964	600.	600.	600.	600.	600.	600.	7008.	22448.	20421.	0.	1359.	600.	55436.
1965	600.	600.	600.	600.	600.	1261.	30673.	22535.	62121.	28657.	2094.	12044.	162384.
1966	9507.	7254.	6330.	5620.	4140.	16538.	24597.	6078.	0.	0.	600.	600.	81263.
1967	600.	600.	600.	600.	600.	8228.	12182.	9087.	38970.	16846.	0.	600.	88913.
1968	600.	600.	600.	600.	4846.	8248.	15797.	5798.	45992.	0.	0.	600.	83680.
1969	2218.	6504.	6190.	6240.	4770.	7078.	39797.	18658.	0.	0.	600.	600.	92654.
1970	600.	600.	600.	600.	600.	1281.	13759.	15601.	10509.	0.	600.	600.	45350.
1971	600.	600.	3543.	8710.	9200.	17278.	26237.	20438.	32322.	0.	0.	600.	119527.
1972	600.	628.	6810.	5760.	6250.	29018.	26867.	27048.	30752.	0.	3110.	600.	137442.
1973	600.	600.	600.	600.	4281.	8060.	24286.	40343.	0.	0.	1712.	600.	81683.
1974	600.	6515.	7980.	6590.	5920.	16048.	32167.	54578.	18072.	0.	0.	600.	149069.
1975	600.	600.	600.	600.	600.	600.	8135.	4650.	40144.	40727.	0.	600.	97856.
1976	600.	2784.	6190.	4850.	4750.	14028.	24617.	9618.	0.	0.	600.	600.	68636.
1977	600.	600.	600.	600.	600.	600.	600.	0.	0.	0.	600.	600.	5400.
1978	600.	600.	600.	600.	600.	600.	7350.	2154.	23645.	0.	3332.	600.	40681.
1979	600.	600.	600.	600.	600.	600.	5511.	0.	0.	0.	600.	600.	10311.
1980	600.	600.	600.	600.	600.	600.	33072.	25204.	8545.	0.	809.	600.	71829.
1981	600.	600.	600.	600.	600.	600.	21564.	6567.	2158.	0.	600.	600.	35089.
1982	600.	600.	600.	600.	600.	7874.	22677.	26898.	15612.	15562.	0.	7314.	98937.
1983	26767.	11104.	5850.	6230.	5650.	13218.	21987.	27928.	106512.	24452.	8258.	16794.	274749.
1984	14407.	10904.	11130.	9040.	7320.	10898.	31907.	84048.	47002.	11182.	58.	13754.	251649.
1985	15127.	10624.	9630.	8400.	7510.	7968.	21487.	18418.	0.	0.	600.	600.	100363.
1986	600.	600.	600.	5013.	17310.	38528.	37117.	78788.	112032.	11592.	0.	600.	302780.
1987	8338.	7754.	6980.	5170.	5850.	10998.	22077.	7748.	0.	0.	600.	600.	76115.
1988	600.	600.	600.	600.	600.	600.	11251.	0.	0.	0.	600.	600.	16051.
1989	600.	600.	600.	600.	600.	600.	5249.	0.	0.	0.	600.	600.	10049.
1990	600.	600.	600.	600.	600.	600.	720.	0.	0.	0.	600.	600.	5520.
1991	600.	600.	600.	600.	600.	600.	600.	0.	0.	0.	600.	600.	5400.
1992	600.	600.	600.	600.	600.	9719.	9184.	0.	0.	0.	600.	600.	23102.
1993	600.	600.	600.	600.	600.	600.	9003.	45698.	13843.	3509.	0.	600.	76253.
1994	600.	600.	600.	3127.	3110.	9418.	13277.	0.	0.	0.	600.	600.	31931.
1995	600.	600.	600.	600.	600.	5176.	5074.	0.	59038.	60571.	0.	600.	133459.
1996	600.	600.	600.	3234.	4240.	10528.	25327.	18768.	9232.	0.	1436.	600.	75164.
1997	600.	600.	600.	600.	2965.	13529.	32311.	26770.	23883.	0.	1774.	600.	104233.
1998	600.	943.	6820.	6190.	5230.	17608.	22217.	14818.	32802.	26102.	0.	600.	133929.
1999	4018.	7754.	6920.	5390.	4940.	14788.	20497.	25498.	29152.	0.	0.	600.	119556.
2000	600.	600.	600.	5544.	5669.	8509.	10758.	0.	0.	0.	600.	600.	33479.
2001	600.	600.	600.	600.	600.	600.	5909.	58.	0.	0.	600.	600.	10767.
2002	600.	600.	600.	600.	600.	600.	600.	0.	0.	0.	600.	600.	5400.
2003	600.	600.	600.	600.	600.	600.	600.	0.	0.	0.	600.	600.	5400.
2004	600.	600.	600.	600.	600.	600.	2003.	0.	0.	0.	600.	600.	6803.
2005	600.	600.	600.	600.	600.	600.	12093.	26373.	7998.	0.	0.	600.	50664.
2006	600.	600.	600.	600.	600.	600.	12741.	13988.	0.	0.	600.	600.	31530.
2007	600.	600.	600.	600.	600.	9856.	11967.	2068.	0.	0.	600.	600.	28091.
2008	600.	600.	600.	600.	600.	600.	600.	8737.	19484.	0.	305.	600.	33325.
2009	600.	600.	600.	600.	600.	600.	10114.	25808.	10682.	0.	0.	600.	50804.
2010	600.	600.	600.	600.	600.	600.	9807.	0.	29778.	0.	0.	600.	43786.
2011	600.	600.	600.	600.	600.	3445.	39837.	41528.	93112.	70552.	0.	600.	252074.
2012	3785.	6349.	4473.	4842.	4074.	16326.	13785.	0.	0.	0.	600.	600.	54833.
MEAN	1706.	1658.	1849.	2057.	2332.	6411.	17617.	14442.	15802.	4489.	795.	1260.	70418.

QX(7) Discharge (ac-ft): Return Flow from Woodruff-Randolph Area

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	ANN
1941	0.	0.	0.	0.	0.	0.	0.	9000.	15400.	11263.	4998.	665.	41326.
1942	0.	0.	0.	0.	0.	0.	0.	9000.	15400.	12600.	5800.	1200.	44000.
1943	0.	0.	0.	0.	0.	0.	0.	9000.	15400.	12600.	8039.	2543.	47582.
1944	896.	0.	0.	0.	0.	0.	0.	9000.	15400.	12600.	8800.	3000.	49696.
1945	1200.	0.	0.	0.	0.	0.	0.	9000.	15400.	12600.	8800.	3000.	50000.
1946	1200.	0.	0.	0.	0.	0.	0.	9000.	15400.	10841.	4745.	497.	41683.
1947	0.	0.	0.	0.	0.	0.	0.	9000.	15400.	12600.	8800.	3000.	48800.
1948	1200.	0.	0.	0.	0.	0.	0.	9000.	15400.	11833.	5340.	893.	43666.
1949	0.	0.	0.	0.	0.	0.	0.	9000.	15400.	12600.	7814.	2408.	47222.
1950	805.	0.	0.	0.	0.	0.	0.	9000.	15400.	12600.	8800.	3000.	49605.
1951	1200.	0.	0.	0.	0.	0.	0.	9000.	15400.	12600.	8800.	3000.	50000.
1952	1200.	0.	0.	0.	0.	0.	0.	9000.	15400.	12600.	8800.	3000.	50000.
1953	1200.	0.	0.	0.	0.	0.	0.	9000.	15400.	12600.	8310.	2706.	49216.
1954	1004.	0.	0.	0.	0.	0.	0.	9000.	8678.	5717.	1401.	60.	25861.
1955	0.	0.	0.	0.	0.	0.	0.	9000.	11671.	7513.	2598.	60.	30842.
1956	0.	0.	0.	0.	0.	0.	0.	9000.	15400.	12600.	5800.	1200.	44000.
1957	0.	0.	0.	0.	0.	0.	0.	9000.	15400.	12600.	8800.	3000.	48800.
1958	1200.	0.	0.	0.	0.	0.	0.	9000.	15400.	10359.	4455.	304.	40718.
1959	0.	0.	0.	0.	0.	0.	0.	8552.	14833.	10690.	4750.	579.	39405.
1960	0.	0.	0.	0.	0.	0.	0.	9000.	12590.	8064.	2966.	60.	32681.
1961	0.	0.	0.	0.	0.	0.	0.	4792.	5031.	3361.	953.	60.	14196.
1962	0.	0.	0.	0.	0.	0.	0.	9000.	15400.	12600.	8036.	2542.	47578.
1963	895.	0.	0.	0.	0.	0.	0.	9000.	15400.	10556.	4573.	382.	40806.
1964	0.	0.	0.	0.	0.	0.	0.	9000.	15400.	12600.	8460.	2796.	48256.
1965	1064.	0.	0.	0.	0.	0.	0.	9000.	15400.	12600.	8800.	3000.	49864.
1966	1200.	0.	0.	0.	0.	0.	0.	9000.	12918.	8261.	3097.	60.	34537.
1967	0.	0.	0.	0.	0.	0.	0.	9000.	15400.	12600.	8800.	3000.	48800.
1968	1200.	0.	0.	0.	0.	0.	0.	9000.	15400.	12600.	8800.	3000.	50000.
1969	1200.	0.	0.	0.	0.	0.	0.	9000.	15400.	12575.	5785.	1190.	45151.
1970	0.	0.	0.	0.	0.	0.	0.	9000.	15400.	12600.	5800.	1200.	44000.
1971	0.	0.	0.	0.	0.	0.	0.	9000.	15400.	12600.	8800.	3000.	48800.
1972	1200.	0.	0.	0.	0.	0.	0.	9000.	15400.	12600.	8023.	2534.	48756.
1973	889.	0.	0.	0.	0.	0.	0.	9000.	15400.	12600.	8372.	2743.	49004.
1974	1029.	0.	0.	0.	0.	0.	0.	9000.	15400.	12600.	8800.	3000.	49829.
1975	1200.	0.	0.	0.	0.	0.	0.	9000.	15400.	12600.	8800.	3000.	50000.
1976	1200.	0.	0.	0.	0.	0.	0.	9000.	15400.	10006.	4243.	162.	40011.
1977	0.	0.	0.	0.	0.	0.	0.	3197.	4701.	3462.	1421.	205.	12988.
1978	0.	0.	0.	0.	0.	0.	0.	9000.	15400.	12600.	7967.	2500.	47467.
1979	867.	0.	0.	0.	0.	0.	0.	9000.	11658.	7525.	2606.	68.	31724.
1980	0.	0.	0.	0.	0.	0.	0.	9000.	15400.	12600.	8598.	2879.	48476.
1981	1119.	0.	0.	0.	0.	0.	0.	9000.	15400.	12600.	5800.	1200.	45119.
1982	0.	0.	0.	0.	0.	0.	0.	9000.	15400.	12600.	8800.	3000.	48800.
1983	1200.	0.	0.	0.	0.	0.	0.	9000.	15400.	12600.	8800.	3000.	50000.
1984	1200.	0.	0.	0.	0.	0.	0.	9000.	15400.	12600.	8800.	3000.	50000.
1985	1200.	0.	0.	0.	0.	0.	0.	9000.	15400.	12600.	5800.	1200.	45200.
1986	0.	0.	0.	0.	0.	0.	0.	9000.	15400.	12600.	8800.	3000.	48800.
1987	1200.	0.	0.	0.	0.	0.	0.	9000.	14758.	9776.	4080.	224.	39039.
1988	0.	0.	0.	0.	0.	0.	0.	9000.	13470.	8592.	3318.	60.	34440.
1989	0.	0.	0.	0.	0.	0.	0.	8560.	10102.	6999.	2344.	238.	28244.
1990	0.	0.	0.	0.	0.	0.	0.	7726.	11280.	7843.	3117.	306.	30273.
1991	0.	0.	0.	0.	0.	0.	0.	9000.	15400.	12600.	5800.	1200.	44000.
1992	0.	0.	0.	0.	0.	0.	0.	9000.	8831.	5853.	1489.	78.	25252.
1993	0.	0.	0.	0.	0.	0.	0.	9000.	15400.	12600.	8800.	3000.	48800.
1994	1200.	0.	0.	0.	0.	0.	0.	9000.	12309.	7896.	2854.	60.	33319.
1995	0.	0.	0.	0.	0.	0.	0.	9000.	15400.	12600.	8800.	3000.	48800.
1996	1200.	0.	0.	0.	0.	0.	0.	9000.	15400.	12600.	8441.	2785.	49426.
1997	1056.	0.	0.	0.	0.	0.	0.	9000.	15400.	12600.	8356.	2734.	49147.
1998	1023.	0.	0.	0.	0.	0.	0.	9000.	15400.	12600.	8800.	3000.	49823.
1999	1200.	0.	0.	0.	0.	0.	0.	9000.	15400.	12600.	8800.	3000.	50000.
2000	1200.	0.	0.	0.	0.	0.	0.	9000.	11354.	7323.	2472.	60.	31409.
2001	0.	0.	0.	0.	0.	0.	0.	9000.	11039.	7297.	2444.	125.	29905.
2002	0.	0.	0.	0.	0.	0.	0.	7171.	6410.	4283.	933.	60.	18856.
2003	0.	0.	0.	0.	0.	0.	0.	9000.	12705.	8509.	3238.	210.	33662.
2004	0.	0.	0.	0.	0.	0.	0.	9000.	9236.	6876.	2119.	390.	27621.
2005	0.	0.	0.	0.	0.	0.	0.	9000.	15400.	12600.	8800.	3000.	48800.
2006	1200.	0.	0.	0.	0.	0.	0.	9000.	15400.	12600.	5800.	1200.	45200.
2007	0.	0.	0.	0.	0.	0.	0.	9000.	12933.	8654.	3334.	213.	34134.
2008	0.	0.	0.	0.	0.	0.	0.	9000.	15400.	12600.	8724.	2954.	48678.
2009	1170.	0.	0.	0.	0.	0.	0.	9000.	15400.	12600.	8800.	3000.	49970.
2010	1200.	0.	0.	0.	0.	0.	0.	9000.	15400.	12600.	8800.	3000.	50000.
2011	1200.	0.	0.	0.	0.	0.	0.	9000.	15400.	12600.	8800.	3000.	50000.
2012	1200.	0.	0.	0.	0.	0.	0.	9000.	6529.	4572.	628.	118.	22046.
MEAN	581.	0.	0.	0.	0.	0.	0.	8806.	14006.	10846.	6195.	1707.	42140.

QX(8) Discharge (ac-ft): Bear River flow below Woodruff-Randolph Area

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	ANN
1941	600.	600.	600.	600.	600.	600.	600.	9000.	15400.	11263.	5598.	1265.	46726.
1942	600.	600.	600.	600.	1718.	7351.	36350.	14332.	17332.	12600.	6400.	1800.	100283.
1943	600.	600.	600.	600.	600.	600.	28082.	12808.	15400.	12600.	11083.	3143.	86717.
1944	1496.	600.	600.	600.	600.	600.	22060.	36997.	34322.	12600.	8800.	3600.	122874.
1945	1800.	600.	600.	600.	600.	600.	16334.	10178.	15400.	12600.	8800.	3600.	71713.
1946	1800.	600.	3467.	4920.	3690.	10738.	37347.	14208.	15400.	10841.	5345.	1097.	109452.
1947	600.	600.	600.	600.	600.	21681.	14363.	31700.	29066.	12600.	8800.	3600.	124811.
1948	1800.	600.	600.	600.	2215.	6318.	34987.	31598.	15400.	11833.	5940.	1493.	113384.
1949	600.	600.	600.	600.	600.	600.	28340.	17651.	19267.	12600.	11759.	3008.	96225.
1950	1405.	600.	600.	600.	600.	2166.	44920.	40122.	61152.	15513.	8800.	3600.	180080.
1951	1800.	600.	600.	1043.	4600.	8498.	37667.	21548.	25142.	12600.	8800.	3600.	126497.
1952	2059.	4834.	5710.	6010.	5950.	6178.	58597.	78908.	46642.	12600.	8800.	3600.	239887.
1953	1800.	600.	1497.	5610.	4080.	6318.	12927.	9000.	21421.	12600.	10270.	3306.	89428.
1954	1604.	600.	600.	600.	600.	600.	8553.	9000.	8678.	5717.	2001.	660.	39214.
1955	600.	600.	600.	600.	600.	600.	600.	9000.	11671.	7513.	3198.	660.	36242.
1956	600.	600.	600.	600.	600.	14022.	14784.	29843.	15400.	12600.	6400.	1800.	97849.
1957	600.	600.	600.	600.	600.	600.	9417.	15538.	72894.	23161.	8800.	3600.	137010.
1958	1800.	600.	600.	600.	600.	5030.	11997.	20468.	15400.	10359.	5055.	904.	73413.
1959	600.	600.	600.	600.	600.	600.	600.	8552.	14833.	10690.	5350.	1179.	44805.
1960	600.	600.	600.	600.	600.	12275.	12820.	9000.	12590.	8064.	3566.	660.	61976.
1961	600.	600.	600.	600.	600.	600.	600.	4792.	5031.	3361.	1553.	660.	19596.
1962	600.	600.	600.	600.	600.	6355.	38411.	14165.	20726.	12600.	11091.	3142.	109489.
1963	1495.	600.	600.	600.	600.	600.	1086.	9000.	15400.	10556.	5173.	982.	46692.
1964	600.	600.	600.	600.	600.	600.	7008.	31448.	35821.	12600.	9820.	3396.	103693.
1965	1664.	600.	600.	600.	600.	1261.	30673.	31535.	77521.	41257.	10894.	15044.	212248.
1966	10707.	7254.	6330.	5620.	4140.	16538.	24597.	15078.	12918.	8261.	3697.	660.	115800.
1967	600.	600.	600.	600.	600.	8228.	12182.	18087.	54370.	29446.	8800.	3600.	137713.
1968	1800.	600.	600.	600.	4846.	8248.	15797.	14798.	61392.	12600.	8800.	3600.	133680.
1969	3418.	6504.	6190.	6240.	4770.	7078.	39797.	27658.	15400.	12575.	6385.	1790.	137805.
1970	600.	600.	600.	600.	600.	1281.	13759.	24601.	25909.	12600.	6400.	1800.	89350.
1971	600.	600.	3543.	8710.	9200.	17278.	26237.	29438.	47722.	12600.	8800.	3600.	168327.
1972	1800.	628.	6810.	5760.	6250.	29018.	26867.	36048.	46152.	12600.	11132.	3134.	186198.
1973	1489.	600.	600.	600.	4281.	8060.	24286.	49343.	15400.	12600.	10084.	3343.	130688.
1974	1629.	6515.	7980.	6590.	5920.	16048.	32167.	63578.	33472.	12600.	8800.	3600.	198898.
1975	1800.	600.	600.	600.	600.	600.	8135.	13650.	55544.	53327.	8800.	3600.	147856.
1976	1800.	2784.	6190.	4850.	4750.	14028.	24617.	18618.	15400.	10006.	4843.	762.	108647.
1977	600.	600.	600.	600.	600.	600.	600.	3197.	4701.	3462.	2021.	805.	18388.
1978	600.	600.	600.	600.	600.	600.	7350.	11154.	39045.	12600.	11299.	3100.	88148.
1979	1467.	600.	600.	600.	600.	600.	5511.	9000.	11658.	7525.	3206.	668.	42036.
1980	600.	600.	600.	600.	600.	600.	33072.	34204.	23945.	12600.	9407.	3479.	120306.
1981	1719.	600.	600.	600.	600.	600.	21564.	15567.	17558.	12600.	6400.	1800.	80208.
1982	600.	600.	600.	600.	600.	7874.	22677.	35898.	31012.	28162.	8800.	10314.	147737.
1983	27967.	11104.	5850.	6230.	5650.	13218.	21987.	36928.	121912.	37052.	17058.	19794.	324749.
1984	15607.	10904.	11130.	9040.	7320.	10898.	31907.	93048.	62402.	23782.	8858.	16754.	301649.
1985	16327.	10624.	9630.	8400.	7510.	7968.	21487.	27418.	15400.	12600.	6400.	1800.	145563.
1986	600.	600.	600.	5013.	17310.	38528.	37117.	87788.	127432.	24192.	8800.	3600.	351580.
1987	9538.	7754.	6980.	5170.	5850.	10998.	22077.	16748.	14758.	9776.	4680.	824.	115154.
1988	600.	600.	600.	600.	600.	600.	11251.	9000.	13470.	8592.	3918.	660.	50491.
1989	600.	600.	600.	600.	600.	600.	5249.	8560.	10102.	6999.	2944.	838.	38293.
1990	600.	600.	600.	600.	600.	600.	720.	7726.	11280.	7843.	3717.	906.	35793.
1991	600.	600.	600.	600.	600.	600.	600.	9000.	15400.	12600.	6400.	1800.	49400.
1992	600.	600.	600.	600.	600.	9719.	9184.	9000.	8831.	5853.	2089.	678.	48354.
1993	600.	600.	600.	600.	600.	600.	9003.	54698.	29243.	16109.	8800.	3600.	125053.
1994	1800.	600.	600.	3127.	3110.	9418.	13277.	9000.	12309.	7896.	3454.	660.	65250.
1995	600.	600.	600.	600.	600.	5176.	5074.	9000.	74439.	73171.	8800.	3600.	182259.
1996	1800.	600.	600.	3234.	4240.	10528.	25327.	27768.	24632.	12600.	9877.	3385.	124590.
1997	1656.	600.	600.	600.	2965.	13529.	32311.	35770.	39283.	12600.	10131.	3334.	153379.
1998	1623.	943.	6820.	6190.	5230.	17608.	22217.	23818.	48202.	38702.	8800.	3600.	183752.
1999	5218.	7754.	6920.	5390.	4940.	14788.	20497.	34498.	44552.	12600.	8800.	3600.	169556.
2000	1800.	600.	600.	5544.	5669.	8509.	10758.	9000.	11354.	7323.	3072.	660.	64888.
2001	600.	600.	600.	600.	600.	600.	5909.	9058.	11039.	7297.	3044.	725.	40671.
2002	600.	600.	600.	600.	600.	600.	600.	7171.	6410.	4283.	1533.	660.	24256.
2003	600.	600.	600.	600.	600.	600.	600.	9000.	12705.	8509.	3838.	810.	39062.
2004	600.	600.	600.	600.	600.	600.	2003.	9000.	9236.	6876.	2719.	990.	34424.
2005	600.	600.	600.	600.	600.	600.	12093.	35373.	23398.	12600.	8800.	3600.	99464.
2006	1800.	600.	600.	600.	600.	600.	12741.	22988.	15400.	12600.	6400.	1800.	76730.
2007	600.	600.	600.	600.	600.	9856.	11967.	11068.	12933.	8654.	3934.	813.	62225.
2008	600.	600.	600.	600.	600.	600.	600.	17737.	34884.	12600.	9028.	3554.	82003.
2009	1770.	600.	600.	600.	600.	600.	10114.	34808.	26082.	12600.	8800.	3600.	100774.
2010	1800.	600.	600.	600.	600.	600.	9807.	9000.	45178.	12600.	8800.	3600.	93786.
2011	1800.	600.	600.	600.	600.	3445.	39837.	50528.	108512.	83152.	8800.	3600.	302074.
2012	4985.	6349.	4473.	4842.	4074.	16326.	13785.	9000.	6529.	4572.	1228.	718.	76880.
MEAN	2287.	1658.	1849.	2057.	2332.	6411.	17617.	23247.	29808.	15335.	6990.	2967.	112558.

WOODRUFF-RANDOLPH AREA SHORTAGE ACRE-FT

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	ANN
1941	0.	0.	0.	0.	0.	0.	0.	0.	0.	5347.	12000.	0.	17347.
1942	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	12000.	0.	12000.
1943	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	3045.	0.	3045.
1944	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1945	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1946	0.	0.	0.	0.	0.	0.	0.	0.	0.	7035.	12000.	0.	19035.
1947	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1948	0.	0.	0.	0.	0.	0.	0.	0.	0.	3067.	12000.	0.	15067.
1949	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	3946.	0.	3946.
1950	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1951	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1952	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1953	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	1960.	0.	1960.
1954	0.	0.	0.	0.	0.	0.	0.	0.	26886.	11400.	12000.	0.	50286.
1955	0.	0.	0.	0.	0.	0.	0.	0.	14917.	11400.	12000.	0.	38317.
1956	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	12000.	0.	12000.
1957	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1958	0.	0.	0.	0.	0.	0.	0.	0.	0.	8964.	12000.	0.	20964.
1959	0.	0.	0.	0.	0.	0.	0.	1790.	1194.	6206.	12000.	0.	21190.
1960	0.	0.	0.	0.	0.	0.	0.	0.	11238.	11400.	12000.	0.	34638.
1961	0.	0.	0.	0.	0.	0.	0.	16834.	31374.	11400.	12000.	0.	71608.
1962	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	3054.	0.	3054.
1963	0.	0.	0.	0.	0.	0.	0.	0.	0.	8177.	12000.	0.	20177.
1964	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	1359.	0.	1359.
1965	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1966	0.	0.	0.	0.	0.	0.	0.	0.	9926.	11400.	12000.	0.	33326.
1967	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1968	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1969	0.	0.	0.	0.	0.	0.	0.	0.	0.	98.	12000.	0.	12098.
1970	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	12000.	0.	12000.
1971	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1972	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	3110.	0.	3110.
1973	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	1712.	0.	1712.
1974	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1975	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1976	0.	0.	0.	0.	0.	0.	0.	0.	0.	10378.	12000.	0.	22378.
1977	0.	0.	0.	0.	0.	0.	0.	23211.	28868.	9946.	12000.	0.	74025.
1978	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	3332.	0.	3332.
1979	0.	0.	0.	0.	0.	0.	0.	0.	14968.	11318.	12000.	0.	38285.
1980	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	809.	0.	809.
1981	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	12000.	0.	12000.
1982	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1983	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1984	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1985	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	12000.	0.	12000.
1986	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1987	0.	0.	0.	0.	0.	0.	0.	0.	2566.	9756.	12000.	0.	24322.
1988	0.	0.	0.	0.	0.	0.	0.	0.	7721.	11400.	12000.	0.	31121.
1989	0.	0.	0.	0.	0.	0.	0.	1758.	20137.	9618.	12000.	0.	43512.
1990	0.	0.	0.	0.	0.	0.	0.	5096.	13421.	8938.	12000.	0.	39454.
1991	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	12000.	0.	12000.
1992	0.	0.	0.	0.	0.	0.	0.	0.	26277.	11220.	12000.	0.	49497.
1993	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1994	0.	0.	0.	0.	0.	0.	0.	0.	12362.	11400.	12000.	0.	35762.
1995	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1996	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	1436.	0.	1436.
1997	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	1774.	0.	1774.
1998	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1999	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
2000	0.	0.	0.	0.	0.	0.	0.	0.	16182.	11400.	12000.	0.	39582.
2001	0.	0.	0.	0.	0.	0.	0.	0.	17445.	10746.	12000.	0.	40191.
2002	0.	0.	0.	0.	0.	0.	0.	7316.	31572.	11400.	12000.	0.	62288.
2003	0.	0.	0.	0.	0.	0.	0.	0.	10780.	9896.	12000.	0.	32675.
2004	0.	0.	0.	0.	0.	0.	0.	0.	24657.	8101.	12000.	0.	44757.
2005	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
2006	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	12000.	0.	12000.
2007	0.	0.	0.	0.	0.	0.	0.	0.	9866.	9866.	12000.	0.	31732.
2008	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	305.	0.	305.
2009	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
2010	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
2011	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
2012	0.	0.	0.	0.	0.	0.	0.	0.	35486.	10822.	12000.	0.	58307.
MEAN	0.	0.	0.	0.	0.	0.	0.	778.	5109.	3640.	6192.	0.	15719.

OLD WOODRUFF NARROWS RESERVOIR END OF MONTH STORAGE ACRE-FT

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	ANN
1941	9836.	10087.	11067.	11922.	12399.	17766.	27008.	15171.	9912.	5018.	4814.	4727.	11644.
1942	9243.	13695.	17705.	20795.	22967.	22967.	22967.	22967.	22967.	12199.	11294.	10485.	17521.
1943	9871.	10152.	11412.	12902.	15752.	25920.	28100.	28100.	25022.	17708.	6233.	5536.	16392.
1944	5689.	6922.	8672.	10622.	12712.	14782.	23776.	23776.	23776.	23224.	10732.	9928.	14551.
1945	9606.	10117.	11137.	13257.	15547.	22834.	28100.	28100.	24062.	21495.	16907.	18267.	18286.
1946	21070.	26247.	28100.	28100.	28100.	28100.	28100.	28100.	9962.	5018.	4200.	3471.	19881.
1947	3864.	7598.	12358.	15818.	19158.	21711.	21711.	21711.	21711.	20086.	10452.	10851.	15586.
1948	12865.	16715.	21155.	25715.	28100.	28100.	28100.	28100.	14092.	5018.	4180.	3452.	17966.
1949	2934.	3839.	6989.	10229.	12959.	18359.	21692.	21692.	21692.	17676.	5332.	4678.	12339.
1950	5835.	8088.	10948.	13648.	16968.	22918.	22918.	22918.	22918.	22918.	12830.	13597.	16375.
1951	16104.	20303.	24753.	28100.	28100.	28100.	28100.	28100.	28100.	26062.	20460.	21606.	24824.
1952	28100.	28100.	28100.	28100.	28100.	28100.	28100.	28100.	28100.	27512.	20979.	22301.	26974.
1953	23872.	25497.	28100.	28100.	28100.	28100.	28100.	12348.	28100.	18912.	7318.	6589.	21928.
1954	6128.	6881.	9951.	13351.	16621.	20957.	24829.	13079.	5018.	4762.	3961.	3236.	10731.
1955	2659.	2475.	3675.	5715.	7515.	8479.	17332.	9855.	5018.	4532.	3837.	3114.	6184.
1956	2688.	4093.	11293.	16673.	20903.	21354.	21354.	21354.	18244.	6959.	6127.	5371.	13034.
1957	4734.	5488.	7638.	9558.	11868.	16329.	23611.	23611.	23611.	23611.	12573.	12422.	14588.
1958	13683.	17002.	20602.	23742.	27362.	28100.	28100.	28100.	7732.	5018.	4180.	3452.	17256.
1959	2884.	2509.	2439.	3499.	5179.	9246.	18976.	5018.	5018.	5018.	4570.	4666.	5752.
1960	7643.	11775.	13185.	14965.	17195.	22906.	22906.	10929.	5018.	4342.	3601.	2892.	11447.
1961	2567.	2802.	4332.	5852.	7312.	8177.	10670.	5018.	5018.	4182.	3635.	4325.	5324.
1962	4484.	5198.	8008.	10398.	21658.	22565.	22565.	22565.	22565.	18095.	6224.	5706.	14169.
1963	5771.	6930.	9228.	9927.	15466.	17096.	23946.	17795.	8488.	5018.	4348.	3897.	10659.
1964	3698.	4952.	7032.	8892.	10302.	12164.	22137.	22137.	22137.	20174.	7919.	7344.	12408.
1965	6880.	7162.	11832.	17352.	21742.	25584.	25584.	25584.	25584.	25584.	25584.	25584.	20338.
1966	28100.	28100.	28100.	28100.	28100.	28100.	28100.	28100.	5018.	4672.	4173.	3975.	20220.
1967	4675.	7329.	12299.	16399.	19809.	22215.	22215.	22215.	22215.	22215.	11657.	11695.	16245.
1968	16567.	20386.	24046.	27446.	28100.	28100.	28100.	28100.	28100.	24782.	19918.	23479.	24760.
1969	28100.	28100.	28100.	28100.	28100.	28100.	28100.	28100.	13632.	5018.	5020.	4960.	21119.
1970	7335.	9938.	12898.	16588.	20268.	23200.	23200.	23200.	23200.	14258.	14340.	15284.	16975.
1971	19536.	24113.	28100.	28100.	28100.	28100.	28100.	28100.	28100.	27042.	15056.	16343.	24899.
1972	21552.	28100.	28100.	28100.	28100.	28100.	28100.	28100.	28100.	18272.	6168.	6082.	23073.
1973	10312.	15153.	19163.	23603.	24322.	24322.	24322.	24322.	20777.	17700.	7566.	14315.	18823.
1974	22839.	28100.	28100.	28100.	28100.	28100.	28100.	28100.	28100.	21342.	9547.	9625.	24013.
1975	10244.	12075.	15185.	18395.	21045.	25568.	27865.	27865.	27865.	27865.	19387.	20963.	21194.
1976	24278.	28100.	28100.	28100.	28100.	28100.	28100.	28100.	5202.	5018.	4760.	4373.	20028.
1977	4595.	5038.	5402.	5814.	6563.	7596.	11564.	5018.	5018.	5018.	4769.	4459.	5904.
1978	4737.	4681.	4741.	5351.	5861.	15297.	22699.	22699.	22699.	17466.	5946.	6972.	11596.
1979	7929.	8854.	10545.	12563.	14591.	19130.	25212.	15864.	5018.	5018.	5025.	4461.	11184.
1980	4659.	5262.	6032.	8542.	11072.	16384.	22701.	22701.	22701.	20348.	8469.	8478.	13112.
1981	9721.	12402.	15322.	18022.	20852.	23825.	26718.	26718.	26718.	15315.	14490.	14192.	18691.
1982	17498.	18215.	20585.	23245.	26415.	28100.	28100.	28100.	28100.	28100.	21638.	28100.	24683.
1983	28100.	28100.	28100.	28100.	28100.	28100.	28100.	28100.	28100.	28100.	28100.	28100.	28100.
1984	28100.	28100.	28100.	28100.	28100.	28100.	28100.	28100.	28100.	28100.	28100.	28100.	28100.
1985	28100.	28100.	28100.	28100.	28100.	28100.	28100.	28100.	14762.	7017.	8084.	9977.	22053.
1986	15414.	20933.	26913.	28100.	28100.	28100.	28100.	28100.	28100.	28100.	22318.	26818.	25758.
1987	28100.	28100.	28100.	28100.	28100.	28100.	28100.	28100.	5018.	5018.	7490.	9219.	20962.
1988	10339.	12410.	13810.	15040.	15930.	21687.	27459.	26902.	5018.	4412.	3720.	3028.	13313.
1989	2748.	2504.	2347.	2163.	2406.	13269.	21268.	5018.	5018.	5018.	5727.	6291.	6148.
1990	7018.	8545.	10214.	12024.	13649.	18106.	24531.	5018.	5018.	5018.	5696.	6190.	10085.
1991	6800.	8002.	8952.	10252.	11332.	12903.	18062.	15611.	16650.	6967.	8435.	9824.	11149.
1992	10580.	15854.	19300.	22671.	26254.	28064.	28064.	15858.	5018.	5018.	4333.	3772.	15399.
1993	3593.	3777.	4167.	4357.	4527.	12745.	22012.	22012.	22012.	22012.	15136.	16683.	12753.
1994	21651.	24397.	27507.	28100.	28100.	28100.	28100.	24178.	5018.	4462.	3788.	3146.	18879.
1995	4440.	4814.	7434.	10324.	14434.	21386.	21386.	9209.	21386.	21386.	14240.	15175.	13801.
1996	19427.	23894.	27804.	28100.	28100.	28100.	28100.	28100.	28100.	19862.	7842.	8058.	22957.
1997	8822.	11623.	16913.	22573.	26298.	26298.	26298.	26298.	26298.	16712.	7504.	11643.	18940.
1998	18705.	28100.	28100.	28100.	28100.	28100.	28100.	28100.	28100.	28100.	23628.	26538.	26814.
1999	28100.	28100.	28100.	28100.	28100.	28100.	28100.	28100.	28100.	24102.	14908.	17146.	25755.
2000	20417.	23487.	28098.	28100.	28100.	28100.	28100.	21812.	5018.	4384.	3593.	3841.	18588.
2001	4612.	6946.	8346.	9576.	11286.	18267.	22081.	22081.	5018.	5018.	4210.	3561.	10083.
2002	3141.	2955.	4363.	6084.	8144.	12314.	18480.	5018.	5018.	4588.	3803.	3197.	6426.
2003	2810.	4405.	5485.	5445.	5425.	9392.	14852.	10724.	5018.	5018.	6280.	7362.	6851.
2004	7411.	7673.	8713.	9858.	10831.	19220.	25602.	8293.	5018.	5018.	6868.	7584.	10174.
2005	9759.	13460.	15330.	18250.	20990.	25483.	25824.	25824.	25824.	21936.	12422.	13313.	19035.
2006	14281.	15430.	17330.	19520.	21720.	27122.	28100.	28100.	15852.	6445.	8472.	10172.	17712.
2007	14958.	19837.	22867.	25307.	27187.	28100.	28100.	28100.	5018.	5018.	5280.	6226.	18000.
2008	8026.	9028.	10618.	12168.	13588.	15337.	22749.	24466.	24466.	19752.	8973.	10577.	14979.
2009	11513.	12323.	13133.	14553.	16073.	21380.	28100.	28100.	28100.	24092.	13308.	14711.	18782.
2010	15854.	17043.	17833.	18833.	20303.	22526.	28100.	19958.	28100.	20432.	9792.	10438.	19101.
2011	11274.	11854.	15554.	20254.	23944.	28100.	28100.	28100.	28100.	28100.	22968.	25573.	22660.
2012	28100.	28100.	28100.	28100.	28100.	28100.	28100.	6950.	5018.	5018.	5374.	6112.	18764.
MEAN	12327.	14257.	16309.	18058.	19764.	22415.	24977.	21695.	17497.	14498.	10008.	10661.	16872.

OLD WOODRUFF NARROWS RESERVOIR EVAPORATION ACRE-FT

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	ANN
1941	63.	9.	0.	0.	0.	20.	85.	284.	355.	427.	248.	137.	1629.
1942	43.	9.	0.	0.	0.	29.	100.	258.	458.	688.	385.	209.	2178.
1943	64.	9.	0.	0.	0.	23.	108.	292.	518.	724.	475.	157.	2369.
1944	47.	7.	0.	0.	0.	20.	77.	263.	468.	702.	562.	204.	2349.
1945	62.	9.	0.	0.	0.	22.	100.	292.	518.	707.	538.	260.	2508.
1946	87.	14.	0.	0.	0.	32.	113.	292.	518.	428.	248.	128.	1861.
1947	37.	6.	0.	0.	0.	26.	97.	250.	444.	666.	514.	201.	2240.
1948	65.	10.	0.	0.	0.	32.	113.	292.	518.	511.	248.	128.	1918.
1949	37.	5.	0.	0.	0.	20.	87.	249.	443.	665.	474.	145.	2127.
1950	43.	7.	0.	0.	0.	24.	100.	258.	458.	687.	558.	223.	2357.
1951	73.	11.	0.	0.	0.	32.	113.	292.	518.	778.	603.	294.	2714.
1952	97.	16.	0.	0.	0.	32.	113.	292.	518.	778.	623.	298.	2768.
1953	99.	15.	0.	0.	0.	32.	113.	292.	318.	778.	495.	169.	2309.
1954	51.	7.	0.	0.	0.	23.	95.	270.	327.	306.	242.	125.	1446.
1955	36.	5.	0.	0.	0.	16.	58.	216.	284.	306.	236.	123.	1279.
1956	36.	5.	0.	0.	0.	27.	96.	247.	439.	595.	293.	156.	1894.
1957	46.	6.	0.	0.	0.	19.	81.	262.	466.	699.	568.	220.	2368.
1958	70.	10.	0.	0.	0.	32.	113.	292.	518.	378.	248.	128.	1789.
1959	37.	5.	0.	0.	0.	13.	60.	229.	204.	306.	248.	134.	1235.
1960	43.	8.	0.	0.	0.	24.	100.	257.	299.	306.	231.	120.	1387.
1961	35.	5.	0.	0.	0.	15.	57.	166.	204.	306.	227.	120.	1134.
1962	41.	6.	0.	0.	0.	28.	99.	255.	454.	681.	481.	157.	2202.
1963	48.	7.	0.	0.	0.	22.	83.	264.	391.	395.	248.	130.	1589.
1964	39.	5.	0.	0.	0.	18.	69.	252.	449.	673.	516.	175.	2197.
1965	54.	7.	0.	0.	0.	28.	107.	275.	489.	733.	596.	336.	2626.
1966	107.	16.	0.	0.	0.	32.	113.	292.	518.	306.	239.	128.	1752.
1967	40.	6.	0.	0.	0.	26.	98.	253.	450.	674.	548.	212.	2307.
1968	68.	12.	0.	0.	0.	32.	113.	292.	518.	778.	585.	288.	2686.
1969	102.	16.	0.	0.	0.	32.	113.	292.	518.	502.	248.	140.	1964.
1970	44.	8.	0.	0.	0.	27.	101.	259.	461.	692.	418.	236.	2246.
1971	78.	13.	0.	0.	0.	32.	113.	292.	518.	778.	617.	243.	2684.
1972	81.	14.	0.	0.	0.	32.	113.	292.	518.	778.	484.	157.	2469.
1973	49.	9.	0.	0.	0.	30.	104.	267.	474.	647.	474.	171.	2226.
1974	75.	14.	0.	0.	0.	32.	113.	292.	518.	778.	535.	192.	2550.
1975	61.	9.	0.	0.	0.	27.	107.	290.	516.	773.	628.	283.	2696.
1976	95.	15.	0.	0.	0.	32.	113.	292.	518.	311.	248.	136.	1762.
1977	42.	6.	0.	0.	0.	15.	55.	173.	204.	306.	248.	136.	1184.
1978	42.	6.	0.	0.	0.	14.	78.	256.	455.	683.	471.	153.	2158.
1979	53.	8.	0.	0.	0.	22.	89.	273.	364.	306.	248.	140.	1503.
1980	42.	6.	0.	0.	0.	19.	81.	256.	455.	683.	519.	181.	2242.
1981	58.	9.	0.	0.	0.	27.	102.	283.	502.	753.	435.	238.	2407.
1982	75.	12.	0.	0.	0.	31.	113.	292.	518.	778.	632.	304.	2755.
1983	113.	16.	0.	0.	0.	32.	113.	292.	518.	778.	632.	356.	2851.
1984	113.	16.	0.	0.	0.	32.	113.	292.	518.	778.	632.	356.	2851.
1985	113.	16.	0.	0.	0.	32.	113.	292.	518.	524.	294.	177.	2080.
1986	63.	11.	0.	0.	0.	32.	113.	292.	518.	778.	632.	310.	2749.
1987	110.	16.	0.	0.	0.	32.	113.	292.	518.	306.	248.	171.	1807.
1988	60.	9.	0.	0.	0.	23.	97.	287.	504.	306.	233.	121.	1640.
1989	35.	5.	0.	0.	0.	9.	72.	246.	204.	306.	248.	150.	1276.
1990	50.	8.	0.	0.	0.	21.	86.	268.	204.	306.	248.	150.	1341.
1991	50.	7.	0.	0.	0.	19.	71.	222.	361.	562.	293.	180.	1766.
1992	62.	9.	0.	0.	0.	31.	113.	291.	364.	306.	248.	130.	1555.
1993	39.	5.	0.	0.	0.	12.	71.	252.	447.	671.	545.	244.	2285.
1994	82.	14.	0.	0.	0.	32.	113.	292.	473.	306.	234.	122.	1668.
1995	36.	6.	0.	0.	0.	22.	96.	247.	274.	659.	536.	236.	2112.
1996	78.	13.	0.	0.	0.	32.	113.	292.	518.	778.	510.	174.	2509.
1997	56.	8.	0.	0.	0.	31.	109.	280.	497.	746.	458.	171.	2356.
1998	67.	13.	0.	0.	0.	32.	113.	292.	518.	778.	632.	320.	2766.
1999	109.	16.	0.	0.	0.	32.	113.	292.	518.	778.	575.	242.	2675.
2000	84.	13.	0.	0.	0.	32.	113.	292.	445.	306.	232.	119.	1636.
2001	39.	6.	0.	0.	0.	19.	87.	252.	448.	306.	248.	128.	1533.
2002	38.	5.	0.	0.	0.	16.	69.	225.	204.	306.	237.	123.	1223.
2003	36.	5.	0.	0.	0.	13.	61.	197.	296.	306.	248.	158.	1320.
2004	54.	8.	0.	0.	0.	19.	90.	275.	260.	306.	248.	164.	1423.
2005	55.	9.	0.	0.	0.	27.	107.	277.	492.	738.	544.	219.	2466.
2006	72.	11.	0.	0.	0.	28.	111.	292.	518.	546.	283.	181.	2042.
2007	63.	11.	0.	0.	0.	32.	113.	292.	518.	306.	248.	144.	1727.
2008	50.	8.	0.	0.	0.	21.	78.	256.	476.	714.	509.	186.	2298.
2009	64.	10.	0.	0.	0.	23.	96.	292.	518.	778.	575.	227.	2582.
2010	76.	11.	0.	0.	0.	27.	99.	292.	420.	778.	520.	195.	2417.
2011	64.	9.	0.	0.	0.	29.	113.	292.	518.	778.	632.	315.	2751.
2012	107.	16.	0.	0.	0.	32.	113.	292.	240.	306.	248.	145.	1500.
MEAN	63.	10.	0.	0.	0.	26.	98.	270.	437.	568.	412.	191.	2073.

OLD WOODRUFF NARROWS RESERVOIR END OF MONTH ELEVATION FEET

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	ANN
1941	6424.5	6424.8	6425.8	6426.7	6427.1	6432.0	6438.7	6429.9	6424.6	6418.1	6417.7	6417.6	6425.6
1942	6423.8	6428.4	6431.9	6434.4	6436.0	6436.0	6436.0	6436.0	6436.0	6426.9	6426.0	6425.2	6431.4
1943	6424.5	6424.9	6426.2	6427.6	6430.4	6437.9	6439.4	6439.4	6437.3	6431.9	6420.0	6418.9	6429.9
1944	6419.2	6420.9	6423.1	6425.4	6427.4	6429.5	6436.5	6436.5	6436.5	6436.1	6425.5	6424.6	6428.4
1945	6424.2	6424.8	6425.9	6428.0	6430.2	6435.9	6439.4	6439.4	6436.7	6435.0	6431.3	6432.4	6431.9
1946	6434.6	6438.2	6439.4	6439.4	6439.4	6439.4	6439.4	6439.4	6424.6	6418.1	6416.7	6415.5	6432.0
1947	6416.2	6421.7	6427.1	6430.4	6433.1	6435.1	6435.1	6435.1	6435.1	6433.8	6425.2	6425.6	6429.5
1948	6427.6	6431.1	6434.7	6437.8	6439.4	6439.4	6439.4	6439.4	6428.8	6418.1	6416.7	6415.5	6430.7
1949	6414.6	6416.2	6421.0	6425.0	6427.7	6432.5	6435.1	6435.1	6435.1	6431.9	6418.6	6417.5	6425.8
1950	6419.4	6422.3	6425.7	6428.4	6431.3	6435.9	6435.9	6435.9	6435.9	6435.9	6427.6	6428.3	6430.2
1951	6430.6	6434.0	6437.2	6439.4	6439.4	6439.4	6439.4	6439.4	6439.4	6438.0	6434.1	6435.1	6437.1
1952	6439.4	6439.4	6439.4	6439.4	6439.4	6439.4	6439.4	6439.4	6439.4	6439.0	6434.6	6435.5	6438.6
1953	6436.6	6437.7	6439.4	6439.4	6439.4	6439.4	6439.4	6427.1	6439.4	6432.9	6421.4	6420.5	6434.4
1954	6419.9	6420.8	6424.6	6428.1	6431.1	6434.5	6437.2	6427.8	6418.1	6417.7	6416.3	6415.2	6424.3
1955	6414.0	6413.6	6415.9	6419.2	6421.6	6422.8	6431.6	6424.5	6418.1	6417.3	6416.1	6415.0	6419.1
1956	6414.0	6416.6	6426.0	6431.1	6434.5	6434.9	6434.9	6434.9	6432.4	6420.9	6419.9	6418.7	6426.6
1957	6417.6	6418.8	6421.8	6424.2	6426.6	6430.8	6436.4	6436.4	6436.4	6436.4	6427.3	6427.2	6428.3
1958	6428.4	6431.4	6434.3	6436.5	6438.9	6439.4	6439.4	6439.4	6421.9	6418.1	6416.7	6415.5	6430.0
1959	6414.5	6413.7	6413.5	6415.6	6418.3	6423.8	6433.0	6418.1	6418.1	6418.1	6417.3	6417.5	6418.4
1960	6421.8	6426.5	6427.9	6429.7	6431.5	6435.9	6435.9	6425.7	6418.1	6417.0	6415.8	6414.5	6425.0
1961	6413.8	6414.3	6417.0	6419.4	6421.4	6422.4	6425.4	6418.1	6418.1	6416.7	6415.8	6416.9	6418.3
1962	6417.2	6418.4	6422.2	6425.2	6435.1	6435.7	6435.7	6435.7	6435.7	6432.2	6420.0	6419.2	6427.7
1963	6419.3	6420.9	6423.7	6424.6	6430.1	6431.4	6436.6	6432.0	6422.8	6418.1	6417.0	6416.2	6424.4
1964	6415.9	6418.0	6421.0	6423.3	6425.1	6426.9	6435.4	6435.4	6435.4	6433.9	6422.1	6421.4	6426.2
1965	6420.8	6421.2	6426.6	6431.6	6435.1	6437.7	6437.7	6437.7	6437.7	6437.7	6437.7	6437.7	6433.3
1966	6439.4	6439.4	6439.4	6439.4	6439.4	6439.4	6439.4	6439.4	6418.1	6417.5	6416.7	6416.4	6432.0
1967	6417.5	6421.4	6427.0	6430.9	6433.6	6435.5	6435.5	6435.5	6435.5	6435.5	6426.4	6426.4	6430.0
1968	6431.0	6434.1	6436.7	6439.0	6439.4	6439.4	6439.4	6439.4	6439.4	6437.2	6433.7	6436.3	6437.1
1969	6439.4	6439.4	6439.4	6439.4	6439.4	6439.4	6439.4	6439.4	6428.4	6418.1	6418.1	6418.0	6433.1
1970	6421.4	6424.6	6427.6	6431.0	6434.0	6436.1	6436.1	6436.1	6436.1	6429.0	6429.1	6430.0	6430.9
1971	6433.4	6436.7	6439.4	6439.4	6439.4	6439.4	6439.4	6439.4	6439.4	6438.7	6429.8	6430.8	6437.1
1972	6435.0	6439.4	6439.4	6439.4	6439.4	6439.4	6439.4	6439.4	6439.4	6432.4	6420.0	6419.8	6435.2
1973	6425.1	6429.9	6433.1	6436.4	6436.9	6436.9	6436.9	6436.9	6434.4	6431.9	6421.7	6429.0	6432.4
1974	6435.9	6439.4	6439.4	6439.4	6439.4	6439.4	6439.4	6439.4	6439.4	6434.8	6424.1	6424.2	6436.2
1975	6425.0	6426.8	6429.9	6432.5	6434.6	6437.7	6439.2	6439.2	6439.2	6439.2	6433.3	6434.5	6434.3
1976	6436.8	6439.4	6439.4	6439.4	6439.4	6439.4	6439.4	6439.4	6418.4	6418.1	6417.7	6417.0	6432.0
1977	6417.4	6418.1	6418.7	6419.4	6420.5	6421.7	6426.3	6418.1	6418.1	6418.1	6417.7	6417.2	6419.3
1978	6417.6	6417.5	6417.6	6418.6	6419.5	6430.0	6435.8	6435.8	6435.8	6431.7	6419.6	6421.0	6425.0
1979	6422.1	6423.3	6425.3	6427.3	6429.3	6433.1	6437.5	6430.5	6418.1	6418.1	6418.1	6417.2	6425.0
1980	6417.5	6418.5	6419.7	6422.9	6425.8	6430.9	6435.8	6435.8	6435.8	6434.1	6422.8	6422.8	6426.9
1981	6424.4	6427.1	6430.0	6432.2	6434.5	6436.5	6438.5	6438.5	6438.5	6430.0	6429.2	6428.9	6432.4
1982	6431.8	6432.3	6434.2	6436.1	6438.3	6439.4	6439.4	6439.4	6439.4	6439.4	6435.1	6439.4	6437.0
1983	6439.4	6439.4	6439.4	6439.4	6439.4	6439.4	6439.4	6439.4	6439.4	6439.4	6439.4	6439.4	6439.4
1984	6439.4	6439.4	6439.4	6439.4	6439.4	6439.4	6439.4	6439.4	6439.4	6439.4	6439.4	6439.4	6439.4
1985	6439.4	6439.4	6439.4	6439.4	6439.4	6439.4	6439.4	6439.4	6429.5	6421.0	6422.3	6424.7	6434.4
1986	6430.1	6434.5	6438.6	6439.4	6439.4	6439.4	6439.4	6439.4	6439.4	6439.4	6435.5	6438.5	6437.8
1987	6439.4	6439.4	6439.4	6439.4	6439.4	6439.4	6439.4	6439.4	6418.1	6418.1	6421.6	6423.7	6433.1
1988	6425.1	6427.1	6428.5	6429.7	6430.5	6435.1	6439.0	6438.6	6418.1	6417.1	6416.0	6414.8	6426.6
1989	6414.2	6413.6	6413.3	6412.9	6413.4	6428.0	6434.8	6418.1	6418.1	6418.1	6419.2	6420.1	6418.7
1990	6421.0	6422.9	6425.0	6426.8	6428.4	6432.3	6437.0	6418.1	6418.1	6418.1	6419.2	6420.0	6423.9
1991	6420.7	6422.2	6423.4	6425.0	6426.1	6427.6	6432.2	6430.3	6431.1	6421.0	6422.8	6424.5	6425.6
1992	6425.3	6430.4	6433.2	6435.8	6438.2	6439.4	6439.4	6430.5	6418.1	6418.1	6417.0	6416.0	6428.4
1993	6415.7	6416.0	6416.7	6417.0	6417.3	6427.5	6435.3	6435.3	6435.3	6435.3	6429.8	6431.1	6426.0
1994	6435.1	6436.9	6439.0	6439.4	6439.4	6439.4	6439.4	6436.8	6418.1	6417.2	6416.1	6415.0	6431.0
1995	6417.1	6417.7	6421.5	6425.1	6429.1	6434.9	6434.9	6423.7	6434.9	6434.9	6429.0	6429.9	6427.7
1996	6433.3	6436.6	6439.2	6439.4	6439.4	6439.4	6439.4	6439.4	6439.4	6433.7	6422.0	6422.3	6435.3
1997	6423.2	6426.4	6431.3	6435.7	6438.2	6438.2	6438.2	6438.2	6438.2	6431.1	6421.6	6426.4	6432.2
1998	6432.7	6439.4	6439.4	6439.4	6439.4	6439.4	6439.4	6439.4	6439.4	6439.4	6436.4	6438.4	6438.5
1999	6439.4	6439.4	6439.4	6439.4	6439.4	6439.4	6439.4	6439.4	6439.4	6436.7	6429.6	6431.5	6437.7
2000	6434.1	6436.3	6439.4	6439.4	6439.4	6439.4	6439.4	6435.2	6418.1	6417.0	6415.7	6416.2	6430.8
2001	6417.4	6420.9	6422.7	6424.2	6426.0	6432.4	6435.4	6435.4	6418.1	6418.1	6416.8	6415.7	6423.6
2002	6415.0	6414.6	6417.0	6419.8	6422.4	6427.0	6432.6	6418.1	6418.1	6417.4	6416.1	6415.1	6419.4
2003	6414.3	6417.1	6418.8	6418.8	6418.7	6423.9	6429.6	6425.5	6418.1	6418.1	6420.1	6421.4	6420.4
2004	6421.5	6421.8	6423.1	6424.5	6425.6	6433.1	6437.7	6422.6	6418.1	6418.1	6420.8	6421.7	6424.1
2005	6424.4	6428.2	6430.0	6432.4	6434.6	6437.6	6437.9	6437.9	6437.9	6435.3	6427.2	6428.0	6432.6
2006	6429.0	6430.1	6431.6	6433.4	6435.1	6438.7	6439.4	6439.4	6430.4	6420.3	6422.8	6424.9	6431.3
2007	6429.7	6433.6	6435.9	6437.5	6438.8	6439.4	6439.4	6439.4	6418.1	6418.1	6418.5	6420.0	6430.7
2008	6422.3	6423.5	6425.4	6426.9	6428.3	6430.0	6435.8	6437.0	6437.0	6433.6	6423.4	6425.3	6429.0
2009	6426.3	6427.1	6427.9	6429.3	6430.6	6434.9	6439.4	6439.4	6439.4	6436.7	6428.0	6429.4	6432.4
2010	6430.4	6431.4	6432.0	6432.8	6434.0	6435.7	6439.4	6433.7	6439.4	6434.1	6424.4	6425.2	6432.7
2011	6426.0	6426.6	6430.2	6434.0	6436.6	6439.4	6439.4	6439.4	6439.4	6439.4	6436.0	6437.7	6435.3
2012	6439.4	6439.4	6439.4	6439.4	6439.4	6439.4	6439.4	6420.9	6418.1	6418.1	6418.7	6419.9	6431.0
MEAN	6425.6	6427.5	6429.5	6431.2	6432.7	6435.1	6437.2	6434.3	6430.3	6427.6	6423.6	6424.1	6429.9

OLD WOODRUFF NARROWS RESERVOIR END OF MONTH SURFACE AREA ACRES

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	ANN
1941	887.	898.	940.	975.	995.	1219.	1580.	1109.	890.	637.	623.	618.	948.
1942	859.	1048.	1217.	1349.	1432.	1432.	1432.	1432.	1432.	986.	949.	916.	1207.
1943	888.	902.	954.	1015.	1134.	1540.	1620.	1620.	1508.	1217.	716.	671.	1149.
1944	681.	748.	831.	922.	1008.	1093.	1462.	1462.	1462.	1442.	926.	891.	1077.
1945	876.	900.	943.	1030.	1125.	1428.	1620.	1620.	1472.	1378.	1183.	1241.	1235.
1946	1360.	1552.	1620.	1620.	1620.	1620.	1620.	1620.	893.	637.	583.	535.	1273.
1947	561.	781.	993.	1136.	1279.	1387.	1387.	1387.	1387.	1318.	915.	931.	1122.
1948	1014.	1175.	1364.	1533.	1620.	1620.	1620.	1620.	1064.	637.	582.	534.	1198.
1949	500.	559.	752.	905.	1018.	1245.	1386.	1386.	1386.	1216.	657.	614.	969.
1950	690.	804.	935.	1046.	1185.	1431.	1431.	1431.	1431.	1431.	1012.	1044.	1156.
1951	1149.	1328.	1498.	1620.	1620.	1620.	1620.	1620.	1620.	1546.	1334.	1383.	1496.
1952	1620.	1620.	1620.	1620.	1620.	1620.	1620.	1620.	1620.	1599.	1356.	1408.	1579.
1953	1466.	1525.	1620.	1620.	1620.	1620.	1620.	993.	1620.	1268.	767.	733.	1373.
1954	710.	747.	892.	1034.	1171.	1356.	1501.	1023.	637.	620.	567.	520.	898.
1955	483.	472.	548.	682.	777.	822.	1201.	888.	637.	605.	559.	512.	682.
1956	485.	576.	949.	1173.	1353.	1372.	1372.	1372.	1240.	750.	710.	660.	1001.
1957	618.	668.	782.	873.	973.	1158.	1456.	1456.	1456.	1456.	1002.	996.	1074.
1958	1048.	1187.	1340.	1461.	1593.	1620.	1620.	1620.	787.	637.	582.	534.	1169.
1959	497.	474.	469.	537.	647.	859.	1271.	637.	637.	637.	607.	614.	657.
1960	783.	969.	1027.	1100.	1195.	1430.	1430.	934.	637.	592.	544.	498.	928.
1961	477.	492.	592.	691.	767.	808.	924.	637.	637.	582.	546.	591.	645.
1962	602.	649.	800.	912.	1385.	1418.	1418.	1418.	1418.	1233.	715.	682.	1054.
1963	686.	749.	858.	891.	1121.	1191.	1468.	1221.	823.	637.	593.	563.	900.
1964	550.	632.	754.	842.	908.	985.	1402.	1402.	1402.	1322.	796.	768.	980.
1965	746.	760.	971.	1202.	1388.	1528.	1528.	1528.	1528.	1528.	1528.	1528.	1314.
1966	1620.	1620.	1620.	1620.	1620.	1620.	1620.	1620.	637.	614.	581.	568.	1280.
1967	614.	768.	991.	1161.	1307.	1405.	1405.	1405.	1405.	1405.	964.	966.	1150.
1968	1168.	1331.	1472.	1596.	1620.	1620.	1620.	1620.	1620.	1499.	1311.	1451.	1494.
1969	1620.	1620.	1620.	1620.	1620.	1620.	1620.	1620.	1045.	637.	637.	633.	1326.
1970	768.	891.	1015.	1169.	1326.	1441.	1441.	1441.	1441.	1071.	1075.	1114.	1183.
1971	1295.	1474.	1620.	1620.	1620.	1620.	1620.	1620.	1620.	1581.	1104.	1159.	1496.
1972	1381.	1620.	1620.	1620.	1620.	1620.	1620.	1620.	1620.	1241.	712.	707.	1417.
1973	909.	1108.	1279.	1456.	1482.	1482.	1482.	1482.	1348.	1217.	779.	1074.	1258.
1974	1428.	1620.	1620.	1620.	1620.	1620.	1620.	1620.	1620.	1372.	873.	877.	1459.
1975	906.	981.	1109.	1246.	1359.	1527.	1611.	1611.	1611.	1611.	1289.	1356.	1352.
1976	1480.	1620.	1620.	1620.	1620.	1620.	1620.	1620.	649.	637.	620.	594.	1277.
1977	609.	638.	662.	689.	731.	780.	960.	637.	637.	637.	620.	600.	683.
1978	618.	615.	618.	659.	692.	1114.	1423.	1423.	1423.	1207.	698.	751.	937.
1979	796.	840.	918.	1001.	1085.	1278.	1515.	1138.	637.	637.	637.	600.	923.
1980	613.	653.	703.	825.	940.	1160.	1423.	1423.	1423.	1330.	822.	822.	1011.
1981	881.	995.	1115.	1230.	1351.	1464.	1570.	1570.	1570.	1115.	1081.	1069.	1251.
1982	1208.	1239.	1340.	1443.	1558.	1620.	1620.	1620.	1620.	1620.	1384.	1620.	1491.
1983	1620.	1620.	1620.	1620.	1620.	1620.	1620.	1620.	1620.	1620.	1620.	1620.	1620.
1984	1620.	1620.	1620.	1620.	1620.	1620.	1620.	1620.	1620.	1620.	1620.	1620.	1620.
1985	1620.	1620.	1620.	1620.	1620.	1620.	1620.	1620.	1092.	753.	804.	893.	1375.
1986	1119.	1355.	1577.	1620.	1620.	1620.	1620.	1620.	1620.	1620.	1409.	1573.	1531.
1987	1620.	1620.	1620.	1620.	1620.	1620.	1620.	1620.	637.	637.	775.	857.	1322.
1988	910.	995.	1053.	1103.	1141.	1386.	1597.	1576.	637.	597.	551.	506.	1004.
1989	489.	474.	464.	452.	467.	1031.	1369.	637.	637.	637.	683.	719.	671.
1990	753.	825.	905.	979.	1046.	1234.	1490.	637.	637.	637.	681.	714.	878.
1991	743.	800.	845.	906.	951.	1015.	1232.	1127.	1172.	751.	820.	886.	937.
1992	920.	1138.	1285.	1422.	1553.	1619.	1619.	1138.	637.	637.	592.	555.	1093.
1993	543.	555.	581.	593.	604.	1009.	1398.	1398.	1398.	1398.	1107.	1173.	980.
1994	1384.	1485.	1598.	1620.	1620.	1620.	1620.	1477.	637.	600.	556.	514.	1228.
1995	599.	623.	773.	909.	1079.	1374.	1374.	857.	1374.	1374.	1071.	1109.	1043.
1996	1290.	1466.	1609.	1620.	1620.	1620.	1620.	1620.	1620.	1309.	792.	802.	1416.
1997	839.	963.	1183.	1418.	1554.	1554.	1554.	1554.	1554.	1174.	776.	964.	1257.
1998	1259.	1620.	1620.	1620.	1620.	1620.	1620.	1620.	1620.	1620.	1457.	1563.	1572.
1999	1620.	1620.	1620.	1620.	1620.	1620.	1620.	1620.	1620.	1474.	1098.	1193.	1529.
2000	1333.	1451.	1620.	1620.	1620.	1620.	1620.	1390.	637.	595.	543.	559.	1217.
2001	610.	750.	816.	874.	949.	1241.	1400.	1400.	637.	637.	584.	541.	870.
2002	513.	502.	594.	707.	806.	991.	1250.	637.	637.	608.	557.	517.	693.
2003	493.	596.	667.	665.	663.	866.	1096.	926.	637.	637.	718.	769.	728.
2004	772.	784.	833.	888.	930.	1281.	1529.	813.	637.	637.	746.	780.	886.
2005	883.	1038.	1116.	1240.	1357.	1524.	1537.	1537.	1537.	1395.	996.	1032.	1266.
2006	1072.	1120.	1201.	1294.	1387.	1584.	1620.	1620.	1138.	726.	822.	903.	1207.
2007	1100.	1308.	1429.	1518.	1587.	1620.	1620.	1620.	637.	637.	654.	715.	1204.
2008	801.	848.	921.	985.	1044.	1116.	1425.	1487.	1487.	1304.	846.	920.	1099.
2009	958.	992.	1025.	1083.	1147.	1374.	1620.	1620.	1620.	1474.	1032.	1090.	1253.
2010	1138.	1189.	1222.	1265.	1328.	1416.	1620.	1313.	1620.	1333.	885.	914.	1270.
2011	948.	972.	1125.	1326.	1468.	1620.	1620.	1620.	1620.	1620.	1433.	1528.	1408.
2012	1620.	1620.	1620.	1620.	1620.	1620.	1620.	750.	637.	637.	660.	709.	1228.
MEAN	963.	1047.	1139.	1214.	1286.	1399.	1503.	1364.	1183.	1056.	867.	891.	1159.

ANNUAL SHORTAGE ACRE-FT AND PERCENT

YEAR	LAND AREA 1 ACRE-FEET	PERCENT
1941	17347.	17.35
1942	12000.	12.00
1943	3045.	3.04
1944	0.	0.00
1945	0.	0.00
1946	19035.	19.03
1947	0.	0.00
1948	15067.	15.07
1949	3946.	3.95
1950	0.	0.00
1951	0.	0.00
1952	0.	0.00
1953	1960.	1.96
1954	50286.	50.29
1955	38317.	38.32
1956	12000.	12.00
1957	0.	0.00
1958	20964.	20.96
1959	21190.	21.19
1960	34638.	34.64
1961	71608.	71.61
1962	3054.	3.05
1963	20177.	20.18
1964	1359.	1.36
1965	0.	0.00
1966	33326.	33.33
1967	0.	0.00
1968	0.	0.00
1969	12098.	12.10
1970	12000.	12.00
1971	0.	0.00
1972	3110.	3.11
1973	1712.	1.71
1974	0.	0.00
1975	0.	0.00
1976	22378.	22.38
1977	74025.	74.02
1978	3332.	3.33
1979	38285.	38.29
1980	809.	0.81
1981	12000.	12.00
1982	0.	0.00
1983	0.	0.00
1984	0.	0.00
1985	12000.	12.00
1986	0.	0.00
1987	24322.	24.32
1988	31121.	31.12
1989	43512.	43.51
1990	39454.	39.45
1991	12000.	12.00
1992	49497.	49.50
1993	0.	0.00
1994	35762.	35.76
1995	0.	0.00
1996	1436.	1.44
1997	1774.	1.77
1998	0.	0.00
1999	0.	0.00
2000	39582.	39.58
2001	40191.	40.19
2002	62288.	62.29
2003	32675.	32.68
2004	44757.	44.76
2005	0.	0.00
2006	12000.	12.00
2007	31732.	31.73
2008	305.	0.30
2009	0.	0.00
2010	0.	0.00
2011	0.	0.00
2012	58307.	58.31
MEAN	15719.	15.72

SUMMARY PAGE

MEAN ANNUAL SURFACE FLOWS

QX(1) =	156718.	QX(2) =	0.	QX(3) =	154699.	QX(4) =	154699.	QX(5) =	84281.	QX(6) =	70418.
QX(7) =	42140.	QX(8) =	112558.	QX(9) =	0.	QX(10) =	0.	QX(11) =	0.	QX(12) =	0.
QX(13) =	0.	QX(14) =	0.	QX(15) =	0.	QX(16) =	0.				

RESERVOIR	INITIAL	END CONTENT	MAXIMUM	MINIMUM	EVAPORATION
OLD WOODRUFF NARROWS RESERVOIR	10000.	6112.	28100.	2163.	2073.

LAND AREA	SHORTAGES	AVG	10-YR	5-YR	2-YR	1-YR
WOODRUFF-RANDOLPH AREA	15719.	15.72%	27.22%	43.90%	53.12%	74.02%

ELAPSED TIME: 0: 0: 0.01

APPENDIX B

Simulation Output Results
for the
Enlarged Woodruff Narrows Reservoir

RESERVOIR SIMULATION INPUT DATA

11:43:55

DATA FILE: D:\FORTRAN\WNRES\WNEnlarge.dat

RESERVOIR PARAMETERS

```
 ENLARGED WOODRUFF NARROWS
NP,SMX ...        15    57300.     5018.    10000.         0         0
EVRT WY       0.07    0.01    0.00    0.00    0.00    0.02    0.07    0.18    0.32    0.48    0.39    0.22      1.76
QRMN WY       600.    600.    600.    600.    600.    600.    600.    600.    600.    600.    600.    600.     7200.
QSM WY          0.      0.      0.      0.      0.      0.      0.      0.      0.      0.      0.      0.        0.

ELEVATION-AREA-CAPACITY TABLE
     6400.0     6404.0     6410.0     6411.7     6415.0     6420.0     6425.0     6430.0     6435.0     6439.4
     6445.0     6450.0     6452.5     6454.5     6460.0
        0.0        9.0      312.0      417.0      513.0      714.0      906.0     1114.0     1380.0     1620.0
     1796.0     2086.0     2112.0     2312.0     2590.0
        0.0       18.0      980.0     1600.0     3135.0     6195.0    10245.0    15295.0    21530.0    28100.0
    37700.0    47405.0    52777.0    57300.0    70780.0
```

LAND USE PARAMETERS

```
 WOODRUFF-RANDOLPH AREA         ACRES =  40000.     EFF =0.500     RFF =1.000
AREAF =     1.000     EFMI =     1.000     QDMIY =     3000.
CUN WY        0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.45    0.50    0.15    0.15    0.00    1.25
QMIP        0.0830  0.0830  0.0830  0.0830  0.0830  0.0830  0.0830  0.0830  0.0840  0.0840  0.0840  0.0840  1.0000
RTFLO FACT    0.50    0.30    0.20    0.00    0.00    0.00    0.00    0.00    0.00    0.00


NYRS,INYR,NRES,NLND,NQIN,NHPW,NFDT,IPQN,IPSH,IPST,IPEV,IPEL,IPSA,IPAS,IOFF,IQMN,IANPLT,IMNPLT,IQMNL,IDISK,IQIFLV,IPQIN
 72  1941   1    1    1    0    0    F    T    T    T    T    T    T    F    F     F      F     F     F      T     F

QX6MN       0.      0.      0.      0.      0.      0.      0.      0.      0.      0.      0.      0.      0.

QIN    FILE
  1  10020100.C

Woodruff Narrows Variables SF(I)
    39940.00    23360.00     6000.00    11760.00     1600.00        0.00        0.00        0.00

ELAPSED TIME:  0: 0: 0.03

ELAPSED TIME:  0: 0: 0.03
```

DIVERSION REQUIREMENTS

USE	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	ANN
LAND AREA 1	WOODRUFF-RANDOLPH AREA												
QDMI	249.	249.	249.	249.	249.	249.	249.	249.	252.	252.	252.	252.	3000.
QDIR	0.	0.	0.	0.	0.	0.	0.	36000.	40000.	12000.	12000.	0.	100000.
TOTAL	249.	249.	249.	249.	249.	249.	249.	36249.	40252.	12252.	12252.	252.	103000.

QX(1) Discharge (ac-ft): Bear River above Woodruff Narrows Reservoir

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	ANN
1941	499.	859.	1580.	1455.	1077.	5987.	9928.	24447.	35096.	2186.	644.	650.	84408.
1942	5160.	5060.	4610.	3690.	3890.	7380.	36450.	41590.	42390.	1920.	80.	0.	152220.
1943	50.	890.	1860.	2090.	3450.	10790.	30370.	40100.	37440.	5410.	1000.	60.	133510.
1944	800.	1840.	2350.	2550.	2690.	2690.	31130.	64260.	59390.	12150.	70.	0.	179920.
1945	340.	1120.	1620.	2720.	2890.	7910.	21700.	37470.	36480.	10140.	7950.	2220.	132560.
1946	3490.	5790.	5320.	4920.	3690.	10770.	37460.	41500.	22380.	450.	30.	0.	135800.
1947	1030.	4340.	5360.	4060.	3940.	24260.	14460.	58950.	54110.	11040.	2880.	1200.	185630.
1948	2680.	4460.	5040.	5160.	4600.	6350.	35100.	58890.	26510.	370.	10.	0.	149170.
1949	120.	1510.	3750.	3840.	3330.	6020.	31760.	44900.	44310.	8650.	130.	90.	148410.
1950	1800.	2860.	3460.	3300.	3920.	8140.	45020.	67380.	86210.	15600.	2470.	1590.	241750.
1951	3180.	4810.	5050.	4390.	4600.	8530.	37780.	48840.	50260.	10740.	7000.	2040.	187220.
1952	7450.	4850.	5710.	6010.	5950.	6210.	58710.	106200.	71760.	12190.	6090.	2220.	293350.
1953	2270.	2240.	4100.	5610.	4080.	6350.	13040.	20540.	62090.	3590.	900.	40.	124850.
1954	190.	1360.	3670.	4000.	3870.	4960.	12520.	24520.	5380.	650.	40.	0.	61160.
1955	60.	420.	1800.	2640.	2400.	1580.	9510.	28740.	20530.	420.	140.	0.	68240.
1956	210.	2010.	7800.	5980.	4830.	14500.	14880.	57090.	37330.	1310.	60.	0.	146000.
1957	10.	1360.	2750.	2520.	2910.	5080.	16780.	42800.	97960.	23260.	1530.	670.	197630.
1958	1930.	3930.	4200.	3740.	4220.	5800.	12110.	47760.	20150.	700.	10.	0.	104550.
1959	70.	230.	530.	1660.	2280.	4680.	10390.	20480.	39010.	6100.	400.	830.	86660.
1960	3620.	4740.	2010.	2380.	2830.	18010.	12920.	24280.	23150.	230.	90.	10.	94270.
1961	310.	840.	2130.	2120.	2060.	1480.	3150.	13680.	8830.	70.	280.	1410.	36360.
1962	800.	1320.	3410.	2990.	11860.	7290.	38510.	41420.	45780.	8210.	610.	240.	162440.
1963	712.	1766.	2898.	1299.	6139.	2253.	8019.	30113.	31083.	748.	178.	280.	85488.
1964	440.	1860.	2680.	2460.	2010.	2480.	17050.	58700.	60870.	10710.	260.	200.	159720.
1965	190.	890.	5270.	6120.	4990.	5130.	30780.	58810.	102610.	41390.	14690.	12380.	283250.
1966	12130.	7270.	6330.	5620.	4140.	16570.	24710.	42370.	7510.	560.	340.	530.	128080.
1967	1340.	3260.	5570.	4700.	4010.	10660.	12280.	45340.	79420.	29520.	1990.	850.	198940.
1968	5540.	4430.	4260.	4000.	5500.	8280.	15910.	42090.	86510.	9460.	7720.	4450.	198150.
1969	6940.	6520.	6190.	6240.	4770.	7110.	39910.	54950.	26050.	3790.	850.	680.	164000.
1970	3020.	3210.	3560.	4290.	4280.	4240.	13860.	51860.	50970.	3750.	1100.	1780.	145920.
1971	4930.	5190.	7530.	8710.	9200.	17310.	26350.	56730.	72840.	11720.	630.	2130.	223270.
1972	5890.	7190.	6810.	5760.	6250.	29050.	26980.	63340.	71270.	2950.	380.	670.	226540.
1973	4880.	5450.	4610.	5040.	5000.	8090.	24390.	76610.	36930.	9570.	2340.	7520.	190430.
1974	9200.	11790.	7980.	6590.	5920.	16080.	32280.	90870.	58590.	6020.	740.	870.	246930.
1975	1280.	2440.	3710.	3810.	3250.	5150.	10540.	40940.	80660.	53500.	4150.	2460.	211890.
1976	4010.	6620.	6190.	4850.	4750.	14060.	24730.	45910.	17620.	1750.	590.	350.	131430.
1977	863.	1049.	964.	1012.	1349.	1648.	4623.	6415.	11336.	2360.	599.	427.	32645.
1978	920.	550.	660.	1210.	1110.	10050.	14830.	38410.	64100.	7450.	950.	1780.	142020.
1979	1609.	1533.	2291.	2618.	2628.	5161.	11683.	26924.	14551.	988.	855.	176.	71017.
1980	840.	1210.	1370.	3110.	3130.	5930.	39470.	61460.	49000.	10330.	640.	790.	177280.
1981	1900.	3290.	3520.	3300.	3430.	3600.	24560.	42850.	42660.	1350.	210.	540.	131210.
1982	3980.	1330.	2970.	3260.	3770.	9590.	22790.	63190.	56130.	28340.	6170.	14080.	215600.
1983	26880.	11120.	5850.	6230.	5650.	13250.	22100.	64220.	147030.	37230.	20890.	17150.	377600.
1984	14520.	10920.	11130.	9040.	7320.	10930.	32020.	120340.	87520.	23960.	12690.	14110.	354500.
1985	15240.	10640.	9630.	8400.	7510.	8000.	21600.	54710.	27180.	4780.	1960.	2670.	172320.
1986	6100.	6130.	6580.	6200.	17310.	38560.	37230.	115080.	152550.	24370.	6850.	5410.	422370.
1987	9730.	7770.	6980.	5170.	5850.	11030.	22190.	44040.	14870.	2550.	3320.	2500.	136000.
1988	1780.	2680.	2000.	1830.	1490.	6380.	17120.	35730.	10900.	300.	140.	30.	80380.
1989	355.	361.	443.	416.	843.	11472.	13321.	18238.	20067.	2688.	1557.	1315.	71076.
1990	1377.	2134.	2269.	2410.	2225.	5078.	7232.	11659.	26783.	3368.	1526.	1244.	67305.
1991	1260.	1810.	1550.	1900.	1680.	2190.	5830.	33770.	41400.	2880.	2360.	2170.	98800.
1992	1418.	5883.	4046.	3971.	4183.	11560.	9297.	24085.	3247.	1086.	163.	169.	69108.
1993	460.	790.	990.	790.	770.	8830.	18340.	81950.	54290.	16180.	5670.	2390.	191450.
1994	5650.	3360.	3710.	3720.	3110.	9450.	13390.	32370.	8950.	350.	160.	80.	84300.
1995	1930.	980.	3220.	3490.	4710.	12150.	5170.	24070.	111490.	73230.	5390.	1770.	247600.
1996	4930.	5080.	4510.	3530.	4240.	10560.	25440.	55060.	49750.	4540.	490.	990.	169120.
1997	1420.	3410.	5890.	6260.	6690.	13560.	32420.	63050.	64380.	3160.	3250.	4910.	208400.
1998	7730.	10350.	6820.	6190.	5230.	17640.	22330.	51110.	73320.	38880.	8160.	3830.	251590.
1999	5690.	7770.	6920.	5390.	4940.	14820.	20610.	61790.	69670.	8780.	3380.	3080.	212840.
2000	3955.	3683.	5211.	5546.	5669.	8541.	10871.	30004.	7468.	272.	41.	967.	82228.
2001	1410.	2940.	2000.	1830.	2310.	7600.	9810.	36310.	5940.	1560.	40.	80.	71830.
2002	218.	419.	2008.	2321.	2660.	4786.	6835.	15447.	8632.	476.	52.	116.	43970.
2003	250.	2200.	1680.	560.	580.	4580.	6120.	32070.	23810.	2410.	2110.	1840.	78210.
2004	703.	870.	1640.	1745.	1573.	9007.	8475.	18966.	12329.	4205.	2698.	1480.	63691.
2005	2830.	4310.	2470.	3520.	3340.	5120.	12540.	62650.	48490.	8850.	3030.	1710.	158860.
2006	1640.	1760.	2500.	2790.	2800.	6030.	13830.	50280.	28270.	3140.	2910.	2480.	118430.
2007	5450.	5490.	3630.	3040.	2480.	10800.	12080.	38360.	7570.	2440.	1110.	1690.	94140.
2008	2450.	1610.	2190.	2150.	2020.	2370.	8090.	46710.	59960.	8000.	1730.	2390.	139670.
2009	1600.	1420.	1410.	2020.	2120.	5930.	16930.	62100.	51200.	8770.	1790.	2230.	157520.
2010	1820.	1800.	1390.	1600.	2070.	2850.	15480.	28150.	78340.	5110.	1880.	1440.	141930.
2011	1500.	1190.	4300.	5300.	4290.	7630.	39950.	77820.	133630.	83330.	7500.	3520.	369960.
2012	6419.	6365.	4473.	4842.	4074.	16358.	13898.	15142.	2822.	1484.	1204.	1484.	78565.
MEAN	3381.	3596.	3902.	3806.	4038.	9087.	20277.	46653.	46932.	10417.	2526.	2104.	156718.

QX(3) Discharge (ac-ft): Outflow from Woodruff Narrows Reservoir

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	ANN
1941	600.	600.	600.	600.	600.	600.	600.	36249.	40252.	6166.	600.	600.	88067.
1942	600.	600.	600.	600.	600.	600.	22502.	41229.	41749.	12252.	12252.	600.	134184.
1943	600.	600.	600.	600.	600.	600.	7981.	39684.	40252.	12252.	12252.	600.	116621.
1944	600.	600.	600.	600.	600.	600.	15746.	63844.	58650.	12252.	12252.	600.	166944.
1945	600.	600.	600.	600.	600.	600.	19046.	37054.	40252.	12252.	12252.	600.	125056.
1946	600.	600.	1659.	4920.	3690.	10724.	37298.	41084.	40252.	12252.	12252.	600.	165931.
1947	600.	600.	600.	600.	600.	600.	13651.	58570.	53435.	12252.	12252.	600.	154360.
1948	600.	600.	600.	600.	2165.	6304.	34938.	58474.	40252.	12252.	12252.	600.	169637.
1949	600.	600.	600.	600.	600.	600.	6550.	44493.	43586.	12252.	12252.	600.	123332.
1950	600.	600.	600.	600.	600.	643.	44858.	66964.	85470.	14490.	12252.	600.	228277.
1951	600.	600.	1526.	4390.	4600.	8484.	37618.	48424.	49520.	12252.	12252.	600.	180866.
1952	600.	3780.	5710.	6010.	5950.	6164.	58548.	105784.	71020.	12252.	12252.	600.	288670.
1953	600.	600.	600.	5196.	4080.	6304.	12878.	36249.	45357.	12252.	12252.	600.	136968.
1954	600.	600.	600.	600.	600.	600.	3762.	36249.	40252.	4848.	600.	600.	89910.
1955	600.	600.	600.	600.	600.	600.	600.	36249.	25076.	600.	600.	600.	67325.
1956	600.	600.	600.	600.	600.	600.	6480.	56738.	40252.	12252.	12252.	600.	132174.
1957	600.	600.	600.	600.	600.	600.	600.	36249.	90558.	22221.	12252.	600.	166080.
1958	600.	600.	600.	600.	600.	5354.	11948.	47344.	40252.	12252.	600.	600.	121350.
1959	600.	600.	600.	600.	600.	600.	600.	36249.	40252.	12252.	600.	600.	94153.
1960	600.	600.	600.	600.	600.	600.	2725.	36249.	40252.	12252.	600.	600.	96278.
1961	600.	600.	600.	600.	600.	600.	600.	24010.	8626.	600.	600.	600.	38636.
1962	600.	600.	600.	600.	600.	600.	22451.	41061.	45143.	12252.	12252.	600.	137359.
1963	600.	600.	600.	600.	600.	600.	600.	36249.	40252.	12252.	600.	600.	94153.
1964	600.	600.	600.	600.	600.	600.	600.	42992.	60166.	12252.	12252.	600.	132462.
1965	600.	600.	600.	600.	600.	653.	30618.	58394.	101870.	40280.	13788.	11871.	260475.
1966	11968.	7247.	6330.	5620.	4140.	16524.	24548.	41954.	40252.	12252.	600.	600.	172035.
1967	600.	600.	600.	600.	600.	600.	600.	42415.	78748.	28512.	12252.	600.	166727.
1968	600.	600.	600.	600.	3101.	8234.	15748.	41674.	85770.	12252.	12252.	600.	182031.
1969	915.	6497.	6190.	6240.	4770.	7064.	39748.	54534.	40252.	12252.	12252.	600.	191314.
1970	600.	600.	600.	600.	600.	600.	600.	46848.	50230.	12252.	12252.	600.	126382.
1971	600.	600.	600.	3632.	9200.	17264.	26188.	56314.	72100.	12252.	12252.	600.	211602.
1972	600.	600.	5491.	5760.	6250.	29004.	26818.	62924.	70530.	12252.	12252.	600.	233081.
1973	600.	600.	600.	600.	600.	6484.	24228.	76194.	40252.	12252.	12252.	600.	175262.
1974	600.	8247.	7980.	6590.	5920.	16034.	32118.	90454.	57850.	12252.	12252.	600.	250897.
1975	600.	600.	600.	600.	600.	600.	6448.	40524.	79920.	52390.	12252.	600.	195734.
1976	600.	2258.	6190.	4850.	4750.	14014.	24568.	45494.	40252.	12252.	600.	600.	156428.
1977	600.	600.	600.	600.	600.	600.	600.	29644.	11132.	2054.	600.	600.	48231.
1978	600.	600.	600.	600.	600.	600.	600.	36249.	50478.	12252.	12252.	600.	116031.
1979	600.	600.	600.	600.	600.	600.	600.	36249.	40252.	9935.	600.	600.	91836.
1980	600.	600.	600.	600.	600.	600.	11372.	61101.	48361.	12252.	12252.	600.	149538.
1981	600.	600.	600.	600.	600.	600.	11384.	42434.	41920.	12252.	12252.	600.	124442.
1982	600.	600.	600.	600.	600.	600.	18489.	62774.	55390.	27230.	12252.	6634.	186369.
1983	26718.	11097.	5850.	6230.	5650.	13204.	21938.	63804.	146290.	36120.	19988.	16641.	373531.
1984	14358.	10897.	11130.	9040.	7320.	10884.	31858.	119924.	86780.	22850.	12252.	13142.	350435.
1985	15078.	10617.	9630.	8400.	7510.	7954.	21438.	54294.	40252.	12252.	12252.	600.	200277.
1986	600.	600.	600.	600.	8339.	38514.	37068.	114664.	151810.	23260.	12252.	600.	388907.
1987	7618.	7747.	6980.	5170.	5850.	10984.	22028.	43624.	40252.	12252.	600.	600.	163704.
1988	600.	600.	600.	600.	600.	600.	600.	36249.	40252.	12252.	600.	600.	94153.
1989	600.	600.	600.	600.	600.	600.	600.	36249.	27398.	2382.	600.	600.	71429.
1990	600.	600.	600.	600.	600.	600.	600.	31023.	26579.	3062.	600.	600.	66065.
1991	600.	600.	600.	600.	600.	600.	600.	36249.	40252.	12252.	600.	600.	94153.
1992	600.	600.	600.	600.	600.	600.	600.	36249.	30199.	780.	600.	600.	72628.
1993	600.	600.	600.	600.	600.	600.	600.	68354.	53658.	15232.	12252.	600.	154295.
1994	600.	600.	600.	600.	600.	6271.	13228.	36249.	40252.	12252.	600.	600.	112452.
1995	600.	600.	600.	600.	600.	600.	600.	36249.	85863.	72235.	12252.	600.	211399.
1996	600.	600.	600.	600.	2490.	10514.	25278.	54644.	49010.	12252.	12252.	600.	169440.
1997	600.	600.	600.	600.	600.	12646.	32258.	62634.	63640.	12252.	12252.	600.	199282.
1998	600.	1229.	6820.	6190.	5230.	17594.	22168.	50694.	72580.	37770.	12252.	600.	233727.
1999	3307.	7747.	6920.	5390.	4940.	14774.	20448.	61374.	68930.	12252.	12252.	600.	218934.
2000	600.	600.	600.	4206.	5669.	8495.	10709.	36249.	40252.	11863.	600.	600.	120442.
2001	600.	600.	600.	600.	600.	600.	600.	36249.	28170.	1254.	600.	600.	71074.
2002	600.	600.	600.	600.	600.	600.	600.	28684.	8428.	600.	600.	600.	43112.
2003	600.	600.	600.	600.	600.	600.	600.	36249.	28974.	2104.	600.	600.	72728.
2004	600.	600.	600.	600.	600.	600.	600.	36249.	16471.	3899.	600.	600.	62019.
2005	600.	600.	600.	600.	600.	600.	600.	52121.	47822.	12252.	12252.	600.	129247.
2006	600.	600.	600.	600.	600.	600.	3995.	49864.	40252.	12252.	12252.	600.	122815.
2007	600.	600.	600.	600.	600.	600.	7796.	37944.	40252.	12252.	600.	600.	103043.
2008	600.	600.	600.	600.	600.	600.	600.	36249.	46039.	12252.	12252.	600.	111592.
2009	600.	600.	600.	600.	600.	600.	9226.	61684.	50460.	12252.	12252.	600.	150074.
2010	600.	600.	600.	600.	600.	600.	8398.	36249.	69155.	12252.	12252.	600.	142507.
2011	600.	600.	600.	600.	600.	2026.	39788.	77404.	132890.	82220.	12252.	600.	350180.
2012	3070.	6342.	4473.	4842.	4074.	16312.	13736.	36249.	33017.	1178.	600.	600.	124494.
MEAN	1687.	1663.	1765.	1876.	2023.	4934.	13995.	49137.	52401.	14795.	8173.	1237.	153685.

QX(5) Discharge (ac-ft): Diversions to Service Woodruff-Randolph Area

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	ANN
1941	249.	249.	249.	249.	249.	249.	249.	36249.	40252.	6166.	252.	252.	84914.
1942	249.	249.	249.	249.	249.	249.	249.	36249.	40252.	12252.	12252.	252.	103000.
1943	249.	249.	249.	249.	249.	249.	249.	36249.	40252.	12252.	12252.	252.	103000.
1944	249.	249.	249.	249.	249.	249.	249.	36249.	40252.	12252.	12252.	252.	103000.
1945	249.	249.	249.	249.	249.	249.	249.	36249.	40252.	12252.	12252.	252.	103000.
1946	249.	249.	249.	249.	249.	249.	249.	36249.	40252.	12252.	8660.	252.	99408.
1947	249.	249.	249.	249.	249.	249.	249.	36249.	40252.	12252.	12252.	252.	103000.
1948	249.	249.	249.	249.	249.	249.	249.	36249.	40252.	12252.	12252.	252.	103000.
1949	249.	249.	249.	249.	249.	249.	249.	36249.	40252.	12252.	12252.	252.	103000.
1950	249.	249.	249.	249.	249.	249.	249.	36249.	40252.	12252.	12252.	252.	103000.
1951	249.	249.	249.	249.	249.	249.	249.	36249.	40252.	12252.	12252.	252.	103000.
1952	249.	249.	249.	249.	249.	249.	249.	36249.	40252.	12252.	12252.	252.	103000.
1953	249.	249.	249.	249.	249.	249.	249.	36249.	40252.	12252.	12252.	252.	103000.
1954	249.	249.	249.	249.	249.	249.	249.	36249.	40252.	4848.	252.	252.	83596.
1955	249.	249.	249.	249.	249.	249.	249.	36249.	25076.	600.	252.	252.	64172.
1956	249.	249.	249.	249.	249.	249.	249.	36249.	40252.	12252.	10332.	252.	101080.
1957	249.	249.	249.	249.	249.	249.	249.	36249.	40252.	12252.	12252.	252.	103000.
1958	249.	249.	249.	249.	249.	249.	249.	36249.	40252.	12252.	252.	252.	91000.
1959	249.	249.	249.	249.	249.	249.	249.	36249.	40252.	12252.	252.	252.	91000.
1960	249.	249.	249.	249.	249.	249.	249.	36249.	40252.	12252.	252.	252.	91000.
1961	249.	249.	249.	249.	249.	249.	249.	24010.	8626.	600.	252.	252.	35483.
1962	249.	249.	249.	249.	249.	249.	249.	36249.	40252.	12252.	12252.	252.	103000.
1963	249.	249.	249.	249.	249.	249.	249.	36249.	40252.	12252.	252.	252.	91000.
1964	249.	249.	249.	249.	249.	249.	249.	36249.	40252.	12252.	12252.	252.	103000.
1965	249.	249.	249.	249.	249.	249.	249.	36249.	40252.	12252.	12252.	252.	103000.
1966	249.	249.	249.	249.	249.	249.	249.	36249.	40252.	12252.	252.	252.	91000.
1967	249.	249.	249.	249.	249.	249.	249.	36249.	40252.	12252.	12252.	252.	103000.
1968	249.	249.	249.	249.	249.	249.	249.	36249.	40252.	12252.	12252.	252.	103000.
1969	249.	249.	249.	249.	249.	249.	249.	36249.	40252.	12252.	12252.	252.	103000.
1970	249.	249.	249.	249.	249.	249.	249.	36249.	40252.	12252.	12252.	252.	103000.
1971	249.	249.	249.	249.	249.	249.	249.	36249.	40252.	12252.	12252.	252.	103000.
1972	249.	249.	249.	249.	249.	249.	249.	36249.	40252.	12252.	12252.	252.	103000.
1973	249.	249.	249.	249.	249.	249.	249.	36249.	40252.	12252.	12252.	252.	103000.
1974	249.	249.	249.	249.	249.	249.	249.	36249.	40252.	12252.	12252.	252.	103000.
1975	249.	249.	249.	249.	249.	249.	249.	36249.	40252.	12252.	12252.	252.	103000.
1976	249.	249.	249.	249.	249.	249.	249.	36249.	40252.	12252.	252.	252.	91000.
1977	249.	249.	249.	249.	249.	249.	249.	29644.	11132.	2054.	252.	252.	45078.
1978	249.	249.	249.	249.	249.	249.	249.	36249.	40252.	12252.	12252.	252.	103000.
1979	249.	249.	249.	249.	249.	249.	249.	36249.	40252.	9935.	252.	252.	88683.
1980	249.	249.	249.	249.	249.	249.	249.	36249.	40252.	12252.	12252.	252.	103000.
1981	249.	249.	249.	249.	249.	249.	249.	36249.	40252.	12252.	12252.	252.	103000.
1982	249.	249.	249.	249.	249.	249.	249.	36249.	40252.	12252.	12252.	252.	103000.
1983	249.	249.	249.	249.	249.	249.	249.	36249.	40252.	12252.	12252.	252.	103000.
1984	249.	249.	249.	249.	249.	249.	249.	36249.	40252.	12252.	12252.	252.	103000.
1985	249.	249.	249.	249.	249.	249.	249.	36249.	40252.	12252.	12252.	252.	103000.
1986	249.	249.	249.	249.	249.	249.	249.	36249.	40252.	12252.	12252.	252.	103000.
1987	249.	249.	249.	249.	249.	249.	249.	36249.	40252.	12252.	252.	252.	91000.
1988	249.	249.	249.	249.	249.	249.	249.	36249.	40252.	12252.	252.	252.	91000.
1989	249.	249.	249.	249.	249.	249.	249.	36249.	27398.	2382.	252.	252.	68276.
1990	249.	249.	249.	249.	249.	249.	249.	31023.	26579.	3062.	252.	252.	62912.
1991	249.	249.	249.	249.	249.	249.	249.	36249.	40252.	12252.	252.	252.	91000.
1992	249.	249.	249.	249.	249.	249.	249.	36249.	30199.	780.	252.	252.	69475.
1993	249.	249.	249.	249.	249.	249.	249.	36249.	40252.	12252.	12252.	252.	103000.
1994	249.	249.	249.	249.	249.	249.	249.	36249.	40252.	12252.	252.	252.	91000.
1995	249.	249.	249.	249.	249.	249.	249.	36249.	40252.	12252.	12252.	252.	103000.
1996	249.	249.	249.	249.	249.	249.	249.	36249.	40252.	12252.	12252.	252.	103000.
1997	249.	249.	249.	249.	249.	249.	249.	36249.	40252.	12252.	12252.	252.	103000.
1998	249.	249.	249.	249.	249.	249.	249.	36249.	40252.	12252.	12252.	252.	103000.
1999	249.	249.	249.	249.	249.	249.	249.	36249.	40252.	12252.	12252.	252.	103000.
2000	249.	249.	249.	249.	249.	249.	249.	36249.	40252.	11863.	252.	252.	90611.
2001	249.	249.	249.	249.	249.	249.	249.	36249.	28170.	1254.	252.	252.	67921.
2002	249.	249.	249.	249.	249.	249.	249.	28684.	8428.	600.	252.	252.	39959.
2003	249.	249.	249.	249.	249.	249.	249.	36249.	28974.	2104.	252.	252.	69575.
2004	249.	249.	249.	249.	249.	249.	249.	36249.	16471.	3899.	252.	252.	58866.
2005	249.	249.	249.	249.	249.	249.	249.	36249.	40252.	12252.	12252.	252.	103000.
2006	249.	249.	249.	249.	249.	249.	249.	36249.	40252.	12252.	12252.	252.	103000.
2007	249.	249.	249.	249.	249.	249.	249.	36249.	40252.	12252.	252.	252.	91000.
2008	249.	249.	249.	249.	249.	249.	249.	36249.	40252.	12252.	12252.	252.	103000.
2009	249.	249.	249.	249.	249.	249.	249.	36249.	40252.	12252.	12252.	252.	103000.
2010	249.	249.	249.	249.	249.	249.	249.	36249.	40252.	12252.	12252.	252.	103000.
2011	249.	249.	249.	249.	249.	249.	249.	36249.	40252.	12252.	12252.	252.	103000.
2012	249.	249.	249.	249.	249.	249.	249.	36249.	33017.	1178.	252.	252.	72692.
MEAN	249.	249.	249.	249.	249.	249.	249.	35810.	37492.	10412.	7842.	252.	93551.

QX(6) Discharge (ac-ft): Bear River Bypassing Diversions

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	ANN
1941	351.	351.	351.	351.	351.	351.	351.	0.	0.	0.	348.	348.	3153.
1942	351.	351.	351.	351.	351.	351.	22253.	4980.	1497.	0.	0.	348.	31184.
1943	351.	351.	351.	351.	351.	351.	7732.	3435.	0.	0.	0.	348.	13621.
1944	351.	351.	351.	351.	351.	351.	15497.	27595.	18398.	0.	0.	348.	63944.
1945	351.	351.	351.	351.	351.	351.	18797.	805.	0.	0.	0.	348.	22056.
1946	351.	351.	1410.	4671.	3441.	10475.	37049.	4835.	0.	0.	3592.	348.	66523.
1947	351.	351.	351.	351.	351.	351.	13402.	22321.	13183.	0.	0.	348.	51360.
1948	351.	351.	351.	351.	1916.	6055.	34689.	22225.	0.	0.	0.	348.	66637.
1949	351.	351.	351.	351.	351.	351.	6301.	8244.	3334.	0.	0.	348.	20332.
1950	351.	351.	351.	351.	351.	394.	44609.	30715.	45218.	2238.	0.	348.	125277.
1951	351.	351.	1277.	4141.	4351.	8235.	37369.	12175.	9268.	0.	0.	348.	77866.
1952	351.	3531.	5461.	5761.	5701.	5915.	58299.	69535.	30768.	0.	0.	348.	185670.
1953	351.	351.	351.	4947.	3831.	6055.	12629.	0.	5105.	0.	0.	348.	33968.
1954	351.	351.	351.	351.	351.	351.	3513.	0.	0.	0.	348.	348.	6315.
1955	351.	351.	351.	351.	351.	351.	351.	0.	0.	0.	348.	348.	3153.
1956	351.	351.	351.	351.	351.	351.	6231.	20489.	0.	0.	1920.	348.	31094.
1957	351.	351.	351.	351.	351.	351.	351.	0.	50306.	9969.	0.	348.	63080.
1958	351.	351.	351.	351.	351.	5106.	11699.	11095.	0.	0.	348.	348.	30350.
1959	351.	351.	351.	351.	351.	351.	351.	0.	0.	0.	348.	348.	3153.
1960	351.	351.	351.	351.	351.	351.	2476.	0.	0.	0.	348.	348.	5278.
1961	351.	351.	351.	351.	351.	351.	351.	0.	0.	0.	348.	348.	3153.
1962	351.	351.	351.	351.	351.	351.	22202.	4812.	4891.	0.	0.	348.	34359.
1963	351.	351.	351.	351.	351.	351.	351.	0.	0.	0.	348.	348.	3153.
1964	351.	351.	351.	351.	351.	351.	351.	6743.	19914.	0.	0.	348.	29462.
1965	351.	351.	351.	351.	351.	404.	30369.	22145.	61618.	28028.	1536.	11619.	157475.
1966	11719.	6998.	6081.	5371.	3891.	16275.	24299.	5705.	0.	0.	348.	348.	81035.
1967	351.	351.	351.	351.	351.	351.	351.	6166.	38496.	16260.	0.	348.	63727.
1968	351.	351.	351.	351.	2852.	7985.	15499.	5425.	45518.	0.	0.	348.	79031.
1969	666.	6248.	5941.	5991.	4521.	6815.	39499.	18285.	0.	0.	0.	348.	88314.
1970	351.	351.	351.	351.	351.	351.	351.	10599.	9978.	0.	0.	348.	23382.
1971	351.	351.	351.	3383.	8951.	17015.	25939.	20065.	31848.	0.	0.	348.	108602.
1972	351.	351.	5242.	5511.	6001.	28755.	26569.	26675.	30278.	0.	0.	348.	130081.
1973	351.	351.	351.	351.	351.	6235.	23979.	39945.	0.	0.	0.	348.	72262.
1974	351.	7998.	7731.	6341.	5671.	15785.	31869.	54205.	17598.	0.	0.	348.	147897.
1975	351.	351.	351.	351.	351.	351.	6199.	4275.	39668.	40138.	0.	348.	92734.
1976	351.	2009.	5941.	4601.	4501.	13765.	24319.	9245.	0.	0.	348.	348.	65428.
1977	351.	351.	351.	351.	351.	351.	351.	0.	0.	0.	348.	348.	3153.
1978	351.	351.	351.	351.	351.	351.	351.	0.	10226.	0.	0.	348.	13031.
1979	351.	351.	351.	351.	351.	351.	351.	0.	0.	0.	348.	348.	3153.
1980	351.	351.	351.	351.	351.	351.	11123.	24852.	8109.	0.	0.	348.	46538.
1981	351.	351.	351.	351.	351.	351.	11135.	6185.	1668.	0.	0.	348.	21442.
1982	351.	351.	351.	351.	351.	351.	18240.	26525.	15138.	14978.	0.	6382.	83369.
1983	26469.	10848.	5601.	5981.	5401.	12955.	21689.	27555.	106038.	23868.	7736.	16389.	270531.
1984	14109.	10648.	10881.	8791.	7071.	10635.	31609.	83675.	46528.	10598.	0.	12890.	247435.
1985	14829.	10368.	9381.	8151.	7261.	7705.	21189.	18045.	0.	0.	0.	348.	97277.
1986	351.	351.	351.	351.	8090.	38265.	36819.	78415.	111558.	11008.	0.	348.	285907.
1987	7369.	7498.	6731.	4921.	5601.	10735.	21779.	7375.	0.	0.	348.	348.	72704.
1988	351.	351.	351.	351.	351.	351.	351.	0.	0.	0.	348.	348.	3153.
1989	351.	351.	351.	351.	351.	351.	351.	0.	0.	0.	348.	348.	3153.
1990	351.	351.	351.	351.	351.	351.	351.	0.	0.	0.	348.	348.	3153.
1991	351.	351.	351.	351.	351.	351.	351.	0.	0.	0.	348.	348.	3153.
1992	351.	351.	351.	351.	351.	351.	351.	0.	0.	0.	348.	348.	3153.
1993	351.	351.	351.	351.	351.	351.	351.	32105.	13406.	2980.	0.	348.	51295.
1994	351.	351.	351.	351.	351.	6022.	12979.	0.	0.	0.	348.	348.	21452.
1995	351.	351.	351.	351.	351.	351.	351.	0.	45611.	59983.	0.	348.	108399.
1996	351.	351.	351.	351.	2241.	10265.	25029.	18395.	8758.	0.	0.	348.	66440.
1997	351.	351.	351.	351.	351.	12397.	32009.	26385.	23388.	0.	0.	348.	96282.
1998	351.	980.	6571.	5941.	4981.	17345.	21919.	14445.	32328.	25518.	0.	348.	130727.
1999	3058.	7498.	6671.	5141.	4691.	14525.	20199.	25125.	28678.	0.	0.	348.	115934.
2000	351.	351.	351.	3957.	5420.	8246.	10460.	0.	0.	0.	348.	348.	29831.
2001	351.	351.	351.	351.	351.	351.	351.	0.	0.	0.	348.	348.	3153.
2002	351.	351.	351.	351.	351.	351.	351.	0.	0.	0.	348.	348.	3153.
2003	351.	351.	351.	351.	351.	351.	351.	0.	0.	0.	348.	348.	3153.
2004	351.	351.	351.	351.	351.	351.	351.	0.	0.	0.	348.	348.	3153.
2005	351.	351.	351.	351.	351.	351.	351.	15872.	7570.	0.	0.	348.	26247.
2006	351.	351.	351.	351.	351.	351.	3746.	13615.	0.	0.	0.	348.	19815.
2007	351.	351.	351.	351.	351.	351.	7547.	1695.	0.	0.	348.	348.	12043.
2008	351.	351.	351.	351.	351.	351.	351.	0.	5787.	0.	0.	348.	8592.
2009	351.	351.	351.	351.	351.	351.	8977.	25435.	10208.	0.	0.	348.	47074.
2010	351.	351.	351.	351.	351.	351.	8149.	0.	28903.	0.	0.	348.	39507.
2011	351.	351.	351.	351.	351.	1777.	39539.	41155.	92638.	69968.	0.	348.	247180.
2012	2821.	6093.	4224.	4593.	3825.	16063.	13487.	0.	0.	0.	348.	348.	51802.
MEAN	1438.	1414.	1516.	1627.	1774.	4685.	13746.	13328.	14909.	4382.	331.	985.	60134.

QX(7) Discharge (ac-ft): Return Flow from Woodruff-Randolph Area

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	ANN
1941	0.	0.	0.	0.	0.	0.	0.	9000.	15400.	11079.	4887.	591.	40957.
1942	0.	0.	0.	0.	0.	0.	0.	9000.	15400.	12600.	8800.	3000.	48800.
1943	1200.	0.	0.	0.	0.	0.	0.	9000.	15400.	12600.	8800.	3000.	50000.
1944	1200.	0.	0.	0.	0.	0.	0.	9000.	15400.	12600.	8800.	3000.	50000.
1945	1200.	0.	0.	0.	0.	0.	0.	9000.	15400.	12600.	8800.	3000.	50000.
1946	1200.	0.	0.	0.	0.	0.	0.	9000.	15400.	12600.	7902.	2461.	48563.
1947	841.	0.	0.	0.	0.	0.	0.	9000.	15400.	12600.	8800.	3000.	49641.
1948	1200.	0.	0.	0.	0.	0.	0.	9000.	15400.	12600.	8800.	3000.	50000.
1949	1200.	0.	0.	0.	0.	0.	0.	9000.	15400.	12600.	8800.	3000.	50000.
1950	1200.	0.	0.	0.	0.	0.	0.	9000.	15400.	12600.	8800.	3000.	50000.
1951	1200.	0.	0.	0.	0.	0.	0.	9000.	15400.	12600.	8800.	3000.	50000.
1952	1200.	0.	0.	0.	0.	0.	0.	9000.	15400.	12600.	8800.	3000.	50000.
1953	1200.	0.	0.	0.	0.	0.	0.	9000.	15400.	12600.	8800.	3000.	50000.
1954	1200.	0.	0.	0.	0.	0.	0.	9000.	15400.	10749.	4689.	460.	41498.
1955	0.	0.	0.	0.	0.	0.	0.	9000.	11606.	7411.	2535.	35.	30586.
1956	0.	0.	0.	0.	0.	0.	0.	9000.	15400.	12600.	8320.	2712.	48032.
1957	1008.	0.	0.	0.	0.	0.	0.	9000.	15400.	12600.	8800.	3000.	49808.
1958	1200.	0.	0.	0.	0.	0.	0.	9000.	15400.	12600.	5800.	1200.	45200.
1959	0.	0.	0.	0.	0.	0.	0.	9000.	15400.	12600.	5800.	1200.	44000.
1960	0.	0.	0.	0.	0.	0.	0.	9000.	15400.	12600.	5800.	1200.	44000.
1961	0.	0.	0.	0.	0.	0.	0.	5940.	5658.	3719.	890.	35.	16241.
1962	0.	0.	0.	0.	0.	0.	0.	9000.	15400.	12600.	8800.	3000.	48800.
1963	1200.	0.	0.	0.	0.	0.	0.	9000.	15400.	12600.	5800.	1200.	45200.
1964	0.	0.	0.	0.	0.	0.	0.	9000.	15400.	12600.	8800.	3000.	48800.
1965	1200.	0.	0.	0.	0.	0.	0.	9000.	15400.	12600.	8800.	3000.	50000.
1966	1200.	0.	0.	0.	0.	0.	0.	9000.	15400.	12600.	5800.	1200.	45200.
1967	0.	0.	0.	0.	0.	0.	0.	9000.	15400.	12600.	8800.	3000.	48800.
1968	1200.	0.	0.	0.	0.	0.	0.	9000.	15400.	12600.	8800.	3000.	50000.
1969	1200.	0.	0.	0.	0.	0.	0.	9000.	15400.	12600.	8800.	3000.	50000.
1970	1200.	0.	0.	0.	0.	0.	0.	9000.	15400.	12600.	8800.	3000.	50000.
1971	1200.	0.	0.	0.	0.	0.	0.	9000.	15400.	12600.	8800.	3000.	50000.
1972	1200.	0.	0.	0.	0.	0.	0.	9000.	15400.	12600.	8800.	3000.	50000.
1973	1200.	0.	0.	0.	0.	0.	0.	9000.	15400.	12600.	8800.	3000.	50000.
1974	1200.	0.	0.	0.	0.	0.	0.	9000.	15400.	12600.	8800.	3000.	50000.
1975	1200.	0.	0.	0.	0.	0.	0.	9000.	15400.	12600.	8800.	3000.	50000.
1976	1200.	0.	0.	0.	0.	0.	0.	9000.	15400.	12600.	5800.	1200.	45200.
1977	0.	0.	0.	0.	0.	0.	0.	7349.	7129.	5022.	1358.	180.	21039.
1978	0.	0.	0.	0.	0.	0.	0.	9000.	15400.	12600.	8800.	3000.	48800.
1979	1200.	0.	0.	0.	0.	0.	0.	9000.	15400.	12021.	5452.	968.	44041.
1980	0.	0.	0.	0.	0.	0.	0.	9000.	15400.	12600.	8800.	3000.	48800.
1981	1200.	0.	0.	0.	0.	0.	0.	9000.	15400.	12600.	8800.	3000.	50000.
1982	1200.	0.	0.	0.	0.	0.	0.	9000.	15400.	12600.	8800.	3000.	50000.
1983	1200.	0.	0.	0.	0.	0.	0.	9000.	15400.	12600.	8800.	3000.	50000.
1984	1200.	0.	0.	0.	0.	0.	0.	9000.	15400.	12600.	8800.	3000.	50000.
1985	1200.	0.	0.	0.	0.	0.	0.	9000.	15400.	12600.	8800.	3000.	50000.
1986	1200.	0.	0.	0.	0.	0.	0.	9000.	15400.	12600.	8800.	3000.	50000.
1987	1200.	0.	0.	0.	0.	0.	0.	9000.	15400.	12600.	5800.	1200.	45200.
1988	0.	0.	0.	0.	0.	0.	0.	9000.	15400.	12600.	5800.	1200.	44000.
1989	0.	0.	0.	0.	0.	0.	0.	9000.	12186.	8204.	3034.	213.	32638.
1990	0.	0.	0.	0.	0.	0.	0.	7694.	11198.	7729.	3054.	281.	29956.
1991	0.	0.	0.	0.	0.	0.	0.	9000.	15400.	12600.	5800.	1200.	44000.
1992	0.	0.	0.	0.	0.	0.	0.	9000.	12887.	8224.	3074.	53.	33238.
1993	0.	0.	0.	0.	0.	0.	0.	9000.	15400.	12600.	8800.	3000.	48800.
1994	1200.	0.	0.	0.	0.	0.	0.	9000.	15400.	12600.	5800.	1200.	45200.
1995	0.	0.	0.	0.	0.	0.	0.	9000.	15400.	12600.	8800.	3000.	48800.
1996	1200.	0.	0.	0.	0.	0.	0.	9000.	15400.	12600.	8800.	3000.	50000.
1997	1200.	0.	0.	0.	0.	0.	0.	9000.	15400.	12600.	8800.	3000.	50000.
1998	1200.	0.	0.	0.	0.	0.	0.	9000.	15400.	12600.	8800.	3000.	50000.
1999	1200.	0.	0.	0.	0.	0.	0.	9000.	15400.	12600.	8800.	3000.	50000.
2000	1200.	0.	0.	0.	0.	0.	0.	9000.	15400.	12503.	5742.	1161.	45005.
2001	0.	0.	0.	0.	0.	0.	0.	9000.	12380.	8038.	2942.	100.	32460.
2002	0.	0.	0.	0.	0.	0.	0.	7109.	6309.	4157.	870.	35.	18480.
2003	0.	0.	0.	0.	0.	0.	0.	9000.	12581.	8371.	3150.	185.	33287.
2004	0.	0.	0.	0.	0.	0.	0.	9000.	9455.	6945.	2169.	365.	27933.
2005	0.	0.	0.	0.	0.	0.	0.	9000.	15400.	12600.	8800.	3000.	48800.
2006	1200.	0.	0.	0.	0.	0.	0.	9000.	15400.	12600.	8800.	3000.	50000.
2007	1200.	0.	0.	0.	0.	0.	0.	9000.	15400.	12600.	5800.	1200.	45200.
2008	0.	0.	0.	0.	0.	0.	0.	9000.	15400.	12600.	8800.	3000.	48800.
2009	1200.	0.	0.	0.	0.	0.	0.	9000.	15400.	12600.	8800.	3000.	50000.
2010	1200.	0.	0.	0.	0.	0.	0.	9000.	15400.	12600.	8800.	3000.	50000.
2011	1200.	0.	0.	0.	0.	0.	0.	9000.	15400.	12600.	8800.	3000.	50000.
2012	1200.	0.	0.	0.	0.	0.	0.	9000.	13591.	8746.	3415.	93.	36046.
MEAN	759.	0.	0.	0.	0.	0.	0.	8890.	14644.	11682.	7146.	2155.	45276.

QX(8) Discharge (ac-ft): Bear River flow below Woodruff-Randolph Area

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	ANN
1941	351.	351.	351.	351.	351.	351.	351.	9000.	15400.	11079.	5235.	939.	44110.
1942	351.	351.	351.	351.	351.	351.	22253.	13980.	16897.	12600.	8800.	3348.	79984.
1943	1551.	351.	351.	351.	351.	351.	7732.	12435.	15400.	12600.	8800.	3348.	63621.
1944	1551.	351.	351.	351.	351.	351.	15497.	36595.	33798.	12600.	8800.	3348.	113944.
1945	1551.	351.	351.	351.	351.	351.	18797.	9805.	15400.	12600.	8800.	3348.	72056.
1946	1551.	351.	1410.	4671.	3441.	10475.	37049.	13835.	15400.	12600.	11494.	2809.	115086.
1947	1192.	351.	351.	351.	351.	351.	13402.	31321.	28583.	12600.	8800.	3348.	101001.
1948	1551.	351.	351.	351.	1916.	6055.	34689.	31225.	15400.	12600.	8800.	3348.	116637.
1949	1551.	351.	351.	351.	351.	351.	6301.	17244.	18734.	12600.	8800.	3348.	70332.
1950	1551.	351.	351.	351.	351.	394.	44609.	39715.	60618.	14838.	8800.	3348.	175277.
1951	1551.	351.	1277.	4141.	4351.	8235.	37369.	21175.	24668.	12600.	8800.	3348.	127866.
1952	1551.	3531.	5461.	5761.	5701.	5915.	58299.	78535.	46168.	12600.	8800.	3348.	235670.
1953	1551.	351.	351.	4947.	3831.	6055.	12629.	9000.	20505.	12600.	8800.	3348.	83968.
1954	1551.	351.	351.	351.	351.	351.	3513.	9000.	15400.	10749.	5037.	808.	47813.
1955	351.	351.	351.	351.	351.	351.	351.	9000.	11606.	7411.	2883.	383.	33739.
1956	351.	351.	351.	351.	351.	351.	6231.	29489.	15400.	12600.	10240.	3060.	79126.
1957	1359.	351.	351.	351.	351.	351.	351.	9000.	65706.	22569.	8800.	3348.	112888.
1958	1551.	351.	351.	351.	351.	5106.	11699.	20095.	15400.	12600.	6148.	1548.	75551.
1959	351.	351.	351.	351.	351.	351.	351.	9000.	15400.	12600.	6148.	1548.	47153.
1960	351.	351.	351.	351.	351.	351.	2476.	9000.	15400.	12600.	6148.	1548.	49278.
1961	351.	351.	351.	351.	351.	351.	351.	5940.	5658.	3719.	1238.	383.	19394.
1962	351.	351.	351.	351.	351.	351.	22202.	13812.	20291.	12600.	8800.	3348.	83159.
1963	1551.	351.	351.	351.	351.	351.	351.	9000.	15400.	12600.	6148.	1548.	48353.
1964	351.	351.	351.	351.	351.	351.	351.	15743.	35314.	12600.	8800.	3348.	78262.
1965	1551.	351.	351.	351.	351.	404.	30369.	31145.	77018.	40628.	10336.	14619.	207475.
1966	12919.	6998.	6081.	5371.	3891.	16275.	24299.	14705.	15400.	12600.	6148.	1548.	126235.
1967	351.	351.	351.	351.	351.	351.	351.	15166.	53896.	28860.	8800.	3348.	112527.
1968	1551.	351.	351.	351.	2852.	7985.	15499.	14425.	60918.	12600.	8800.	3348.	129031.
1969	1866.	6248.	5941.	5991.	4521.	6815.	39499.	27285.	15400.	12600.	8800.	3348.	138314.
1970	1551.	351.	351.	351.	351.	351.	351.	19599.	25378.	12600.	8800.	3348.	73382.
1971	1551.	351.	351.	3383.	8951.	17015.	25939.	29065.	47248.	12600.	8800.	3348.	158602.
1972	1551.	351.	5242.	5511.	6001.	28755.	26569.	35675.	45678.	12600.	8800.	3348.	180081.
1973	1551.	351.	351.	351.	351.	6235.	23979.	48945.	15400.	12600.	8800.	3348.	122262.
1974	1551.	7998.	7731.	6341.	5671.	15785.	31869.	63205.	32998.	12600.	8800.	3348.	197897.
1975	1551.	351.	351.	351.	351.	351.	6199.	13275.	55068.	52738.	8800.	3348.	142734.
1976	1551.	2009.	5941.	4601.	4501.	13765.	24319.	18245.	15400.	12600.	6148.	1548.	110628.
1977	351.	351.	351.	351.	351.	351.	351.	7349.	7129.	5022.	1706.	528.	24192.
1978	351.	351.	351.	351.	351.	351.	351.	9000.	25626.	12600.	8800.	3348.	61831.
1979	1551.	351.	351.	351.	351.	351.	351.	9000.	15400.	12021.	5800.	1316.	47194.
1980	351.	351.	351.	351.	351.	351.	11123.	33852.	23509.	12600.	8800.	3348.	95338.
1981	1551.	351.	351.	351.	351.	351.	11135.	15185.	17068.	12600.	8800.	3348.	71442.
1982	1551.	351.	351.	351.	351.	351.	18240.	35525.	30538.	27578.	8800.	9382.	133369.
1983	27669.	10848.	5601.	5981.	5401.	12955.	21689.	36555.	121438.	36468.	16536.	19389.	320531.
1984	15309.	10648.	10881.	8791.	7071.	10635.	31609.	92675.	61928.	23198.	8800.	15890.	297435.
1985	16029.	10368.	9381.	8151.	7261.	7705.	21189.	27045.	15400.	12600.	8800.	3348.	147277.
1986	1551.	351.	351.	351.	8090.	38265.	36819.	87415.	126958.	23608.	8800.	3348.	335907.
1987	8569.	7498.	6731.	4921.	5601.	10735.	21779.	16375.	15400.	12600.	6148.	1548.	117904.
1988	351.	351.	351.	351.	351.	351.	351.	9000.	15400.	12600.	6148.	1548.	47153.
1989	351.	351.	351.	351.	351.	351.	351.	9000.	12186.	8204.	3382.	561.	35791.
1990	351.	351.	351.	351.	351.	351.	351.	7694.	11198.	7729.	3402.	629.	33109.
1991	351.	351.	351.	351.	351.	351.	351.	9000.	15400.	12600.	6148.	1548.	47153.
1992	351.	351.	351.	351.	351.	351.	351.	9000.	12887.	8224.	3422.	401.	36391.
1993	351.	351.	351.	351.	351.	351.	351.	41105.	28806.	15580.	8800.	3348.	100095.
1994	1551.	351.	351.	351.	351.	6022.	12979.	9000.	15400.	12600.	6148.	1548.	66652.
1995	351.	351.	351.	351.	351.	351.	351.	9000.	61011.	72583.	8800.	3348.	157199.
1996	1551.	351.	351.	351.	2241.	10265.	25029.	27395.	24158.	12600.	8800.	3348.	116440.
1997	1551.	351.	351.	351.	351.	12397.	32009.	35385.	38788.	12600.	8800.	3348.	146282.
1998	1551.	980.	6571.	5941.	4981.	17345.	21919.	23445.	47728.	38118.	8800.	3348.	180727.
1999	4258.	7498.	6671.	5141.	4691.	14525.	20199.	34125.	44078.	12600.	8800.	3348.	165934.
2000	1551.	351.	351.	3957.	5420.	8246.	10460.	9000.	15400.	12503.	6090.	1509.	74837.
2001	351.	351.	351.	351.	351.	351.	351.	9000.	12380.	8038.	3290.	448.	35613.
2002	351.	351.	351.	351.	351.	351.	351.	7109.	6309.	4157.	1218.	383.	21633.
2003	351.	351.	351.	351.	351.	351.	351.	9000.	12581.	8371.	3498.	533.	36440.
2004	351.	351.	351.	351.	351.	351.	351.	9000.	9455.	6945.	2517.	713.	31086.
2005	351.	351.	351.	351.	351.	351.	351.	24872.	22970.	12600.	8800.	3348.	75047.
2006	1551.	351.	351.	351.	351.	351.	3746.	22615.	15400.	12600.	8800.	3348.	69815.
2007	1551.	351.	351.	351.	351.	351.	7547.	10695.	15400.	12600.	6148.	1548.	57243.
2008	351.	351.	351.	351.	351.	351.	351.	9000.	21187.	12600.	8800.	3348.	57392.
2009	1551.	351.	351.	351.	351.	351.	8977.	34435.	25608.	12600.	8800.	3348.	97074.
2010	1551.	351.	351.	351.	351.	351.	8149.	9000.	44303.	12600.	8800.	3348.	89507.
2011	1551.	351.	351.	351.	351.	1777.	39539.	50155.	108038.	82568.	8800.	3348.	297180.
2012	4021.	6093.	4224.	4593.	3825.	16063.	13487.	9000.	13591.	8746.	3763.	441.	87848.
MEAN	2197.	1414.	1516.	1627.	1774.	4685.	13746.	22218.	29553.	16065.	7477.	3140.	105410.

WOODRUFF-RANDOLPH AREA SHORTAGE ACRE-FT

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	ANN
1941	0.	0.	0.	0.	0.	0.	0.	0.	0.	6086.	12000.	0.	18086.
1942	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1943	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1944	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1945	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1946	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	3592.	0.	3592.
1947	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1948	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1949	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1950	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1951	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1952	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1953	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1954	0.	0.	0.	0.	0.	0.	0.	0.	0.	7404.	12000.	0.	19404.
1955	0.	0.	0.	0.	0.	0.	0.	0.	15176.	11652.	12000.	0.	38828.
1956	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	1920.	0.	1920.
1957	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1958	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	12000.	0.	12000.
1959	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	12000.	0.	12000.
1960	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	12000.	0.	12000.
1961	0.	0.	0.	0.	0.	0.	0.	12239.	31626.	11652.	12000.	0.	67517.
1962	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1963	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	12000.	0.	12000.
1964	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1965	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1966	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	12000.	0.	12000.
1967	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1968	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1969	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1970	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1971	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1972	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1973	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1974	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1975	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1976	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	12000.	0.	12000.
1977	0.	0.	0.	0.	0.	0.	0.	6605.	29120.	10198.	12000.	0.	57922.
1978	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1979	0.	0.	0.	0.	0.	0.	0.	0.	0.	2317.	12000.	0.	14317.
1980	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1981	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1982	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1983	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1984	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1985	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1986	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1987	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	12000.	0.	12000.
1988	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	12000.	0.	12000.
1989	0.	0.	0.	0.	0.	0.	0.	0.	12854.	9870.	12000.	0.	34724.
1990	0.	0.	0.	0.	0.	0.	0.	5226.	13673.	9190.	12000.	0.	40088.
1991	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	12000.	0.	12000.
1992	0.	0.	0.	0.	0.	0.	0.	0.	10053.	11472.	12000.	0.	33525.
1993	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1994	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	12000.	0.	12000.
1995	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1996	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1997	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1998	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1999	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
2000	0.	0.	0.	0.	0.	0.	0.	0.	0.	389.	12000.	0.	12389.
2001	0.	0.	0.	0.	0.	0.	0.	0.	12082.	10998.	12000.	0.	35079.
2002	0.	0.	0.	0.	0.	0.	0.	7565.	31824.	11652.	12000.	0.	63041.
2003	0.	0.	0.	0.	0.	0.	0.	0.	11278.	10148.	12000.	0.	33425.
2004	0.	0.	0.	0.	0.	0.	0.	0.	23781.	8353.	12000.	0.	44134.
2005	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
2006	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
2007	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	12000.	0.	12000.
2008	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
2009	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
2010	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
2011	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
2012	0.	0.	0.	0.	0.	0.	0.	0.	7235.	11074.	12000.	0.	30308.
MEAN	0.	0.	0.	0.	0.	0.	0.	439.	2760.	1840.	4410.	0.	9449.

ENLARGED WOODRUFF NARROWS END OF MONTH STORAGE ACRE-FT

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	ANN
1941	9836.	10087.	11067.	11922.	12399.	17766.	27008.	14922.	9414.	5018.	4814.	4727.	11581.
1942	9243.	13695.	17705.	20795.	24085.	30835.	44667.	44667.	44667.	33373.	20531.	19637.	26991.
1943	18996.	19273.	20533.	22023.	24873.	35033.	57300.	57300.	53748.	45872.	33824.	32905.	35140.
1944	32985.	34208.	35958.	37908.	39998.	42051.	57300.	57300.	57300.	56088.	43025.	41995.	44676.
1945	41601.	42102.	43122.	45242.	47532.	54800.	57300.	57300.	52788.	49662.	44542.	45722.	48476.
1946	48470.	53639.	57300.	57300.	57300.	57300.	57300.	57300.	38688.	26010.	13186.	12360.	44679.
1947	12720.	16450.	21210.	24670.	28010.	51638.	52300.	52300.	52300.	50075.	39885.	40075.	36803.
1948	42025.	45865.	50305.	54865.	57300.	57300.	57300.	57300.	42818.	30001.	17113.	16251.	44037.
1949	15690.	16589.	19739.	22979.	25709.	31098.	56191.	56191.	56191.	51503.	38560.	37649.	35674.
1950	38723.	40965.	43825.	46525.	49845.	57300.	57300.	57300.	57300.	57300.	46616.	47153.	50013.
1951	49587.	53776.	57300.	57300.	57300.	57300.	57300.	57300.	57300.	54678.	48570.	49550.	54772.
1952	56253.	57300.	57300.	57300.	57300.	57300.	57300.	57300.	57300.	56128.	49085.	50244.	55842.
1953	51767.	53386.	56886.	57300.	57300.	57300.	57300.	41175.	57300.	47528.	35362.	34417.	50585.
1954	33885.	34628.	37698.	41098.	44368.	48688.	57300.	45155.	9637.	5018.	4210.	3481.	30431.
1955	2904.	2719.	3919.	5959.	7759.	8723.	17575.	9848.	5018.	4532.	3837.	3114.	6325.
1956	2688.	4093.	11293.	16673.	20903.	34776.	43054.	43054.	39506.	27676.	14858.	14017.	22716.
1957	13352.	14102.	16252.	18172.	20482.	24935.	41010.	47220.	53957.	53957.	42391.	42035.	32322.
1958	43230.	46540.	50140.	53280.	56900.	57300.	57300.	57300.	36458.	24055.	22891.	21976.	43948.
1959	21349.	20965.	20895.	21955.	23635.	27686.	37363.	21272.	19592.	12817.	12223.	12235.	20999.
1960	15186.	19315.	20725.	22505.	24735.	42115.	52175.	39827.	22130.	9435.	8587.	7814.	23713.
1961	7469.	7701.	9231.	10751.	12211.	13072.	15550.	5018.	5018.	4182.	3635.	4325.	8180.
1962	4484.	5198.	8008.	10398.	21658.	28320.	44265.	44265.	44265.	39267.	26906.	26200.	25270.
1963	26203.	27354.	29652.	30351.	35890.	37507.	44801.	38303.	28554.	16268.	15396.	14830.	28759.
1964	14593.	15842.	17922.	19782.	21192.	23045.	39394.	54770.	54770.	52172.	39357.	38551.	32616.
1965	38014.	38285.	42955.	48475.	52865.	57300.	57300.	57300.	57300.	57300.	57300.	57300.	51808.
1966	57300.	57300.	57300.	57300.	57300.	57300.	57300.	57300.	23818.	11424.	10791.	10517.	42913.
1967	11193.	13843.	18813.	22913.	26323.	36352.	47908.	50457.	50457.	50457.	39376.	39220.	33943.
1968	44031.	47841.	51501.	54901.	57300.	57300.	57300.	57300.	57300.	53398.	48032.	51422.	53135.
1969	57300.	57300.	57300.	57300.	57300.	57300.	57300.	57300.	42358.	32967.	20899.	20681.	47942.
1970	23007.	25603.	28563.	32253.	35933.	39537.	52668.	57300.	57300.	47688.	35722.	36515.	39341.
1971	40721.	45292.	52222.	57300.	57300.	57300.	57300.	57300.	57300.	55658.	43163.	44262.	52093.
1972	49412.	55981.	57300.	57300.	57300.	57300.	57300.	57300.	57300.	46888.	34209.	33898.	51791.
1973	38057.	42889.	46899.	51339.	55739.	57300.	57300.	57300.	53238.	49533.	38803.	45321.	49476.
1974	53779.	57300.	57300.	57300.	57300.	57300.	57300.	57300.	57300.	49958.	37628.	37503.	53106.
1975	38058.	39880.	42990.	46200.	48850.	53358.	57300.	57300.	57300.	57300.	48296.	49696.	49711.
1976	52960.	57300.	57300.	57300.	57300.	57300.	57300.	57300.	33928.	22597.	22034.	21476.	46175.
1977	21643.	22078.	22442.	22854.	23603.	24622.	28540.	5018.	5018.	5018.	4769.	4459.	15839.
1978	4737.	4681.	4741.	5351.	5861.	15297.	29449.	31314.	44399.	38639.	26626.	27461.	19880.
1979	28358.	29275.	30966.	32984.	35012.	39538.	50492.	40788.	14483.	5018.	5025.	4461.	26367.
1980	4659.	5262.	6032.	8542.	11072.	16384.	44401.	44401.	44401.	41520.	29163.	28993.	23736.
1981	30178.	32852.	35772.	38472.	41302.	44263.	57300.	57300.	57300.	45288.	32457.	32023.	42042.
1982	35285.	35997.	38367.	41027.	44197.	53148.	57300.	57300.	57300.	57300.	50316.	57300.	48737.
1983	57300.	57300.	57300.	57300.	57300.	57300.	57300.	57300.	57300.	57300.	57300.	57300.	57300.
1984	57300.	57300.	57300.	57300.	57300.	57300.	57300.	57300.	57300.	57300.	56836.	57300.	57261.
1985	57300.	57300.	57300.	57300.	57300.	57300.	57300.	57300.	43488.	35071.	24097.	25843.	48908.
1986	31236.	36749.	42729.	48329.	57300.	57300.	57300.	57300.	57300.	57300.	50996.	55344.	50765.
1987	57300.	57300.	57300.	57300.	57300.	57300.	57300.	57300.	31178.	20671.	22868.	24453.	46464.
1988	25529.	27594.	28994.	30224.	31114.	36860.	53256.	52353.	22326.	9697.	8894.	8139.	27915.
1989	7837.	7590.	7433.	7249.	7492.	18349.	30983.	12671.	5018.	5018.	5727.	6291.	10138.
1990	7018.	8545.	10214.	12024.	13649.	18106.	24651.	5018.	5018.	5018.	5696.	6190.	10095.
1991	6800.	8002.	8952.	10252.	11332.	12903.	18062.	15362.	16152.	6228.	7709.	9106.	10905.
1992	9864.	15138.	18584.	21955.	25538.	36468.	45041.	32514.	5018.	5018.	4333.	3772.	18604.
1993	3593.	3777.	4167.	4357.	4527.	12745.	30415.	43712.	43712.	43712.	36359.	37759.	22403.
1994	42683.	45424.	48534.	51654.	54164.	57300.	57300.	53005.	21024.	8470.	7709.	7016.	37857.
1995	8294.	8666.	11286.	14176.	18286.	29811.	34265.	21774.	46956.	46956.	39286.	40051.	26650.
1996	44250.	48710.	52620.	55550.	57300.	57300.	57300.	57300.	57300.	48478.	35901.	35903.	50659.
1997	36599.	39392.	44682.	50342.	56432.	57300.	57300.	57300.	57300.	47098.	37286.	41203.	48519.
1998	48200.	57300.	57300.	57300.	57300.	57300.	57300.	57300.	57300.	57300.	52306.	55072.	55940.
1999	57300.	57300.	57300.	57300.	57300.	57300.	57300.	57300.	57300.	52718.	43023.	45073.	54709.
2000	48286.	51349.	55960.	57300.	57300.	57300.	57300.	50639.	17182.	5018.	4211.	4449.	38858.
2001	5217.	7551.	8951.	10181.	11891.	18871.	27993.	27763.	5018.	5018.	4210.	3561.	11352.
2002	3141.	2955.	4363.	6084.	8144.	12314.	18480.	5018.	5018.	4588.	3803.	3197.	6426.
2003	2810.	4405.	5485.	5445.	5425.	9392.	14852.	10475.	5018.	5018.	6280.	7362.	6831.
2004	7411.	7673.	8713.	9858.	10831.	19220.	27005.	9437.	5018.	5018.	6868.	7584.	10386.
2005	9759.	13460.	15330.	18250.	20990.	25483.	37316.	47524.	47524.	43120.	33134.	33868.	28813.
2006	34787.	35930.	37830.	40020.	42220.	47611.	57300.	57300.	44578.	34505.	24486.	26038.	40217.
2007	30780.	35654.	38684.	41124.	43004.	53165.	57300.	57300.	23878.	13363.	13469.	14331.	35171.
2008	16105.	17104.	18694.	20244.	21664.	23406.	30795.	40955.	54271.	48973.	37635.	39030.	30740.
2009	39901.	40703.	41513.	42933.	44453.	49743.	57300.	57300.	57300.	52708.	41423.	42633.	47326.
2010	43717.	44897.	45687.	46687.	48157.	50366.	57300.	48785.	57300.	49048.	37860.	38303.	47342.
2011	39076.	39648.	43348.	48048.	51738.	57300.	57300.	57300.	57300.	57300.	51646.	54103.	51176.
2012	57300.	57300.	57300.	57300.	57300.	57300.	57300.	35777.	5018.	5018.	5374.	6112.	38200.
MEAN	29703.	31622.	33758.	35688.	37703.	41821.	47971.	45114.	39017.	33786.	27510.	28058.	35979.

ENLARGED WOODRUFF NARROWS EVAPORATION ACRE-FT

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	ANN
1941	63.	9.	0.	0.	0.	20.	85.	284.	352.	416.	248.	137.	1614.
1942	43.	9.	0.	0.	0.	29.	117.	361.	641.	962.	669.	294.	3126.
1943	91.	13.	0.	0.	0.	30.	122.	416.	740.	1034.	796.	379.	3622.
1944	120.	17.	0.	0.	0.	37.	135.	416.	740.	1110.	881.	430.	3885.
1945	135.	19.	0.	0.	0.	42.	154.	416.	740.	1014.	818.	440.	3778.
1946	143.	21.	0.	0.	0.	46.	162.	416.	740.	876.	602.	226.	3232.
1947	70.	10.	0.	0.	0.	32.	147.	380.	675.	1013.	819.	409.	3555.
1948	131.	19.	0.	0.	0.	46.	162.	416.	740.	935.	645.	262.	3357.
1949	81.	11.	0.	0.	0.	31.	117.	407.	724.	1086.	821.	401.	3680.
1950	126.	18.	0.	0.	0.	42.	162.	416.	740.	1110.	902.	454.	3969.
1951	145.	21.	0.	0.	0.	46.	162.	416.	740.	1110.	856.	460.	3957.
1952	147.	23.	0.	0.	0.	46.	162.	416.	740.	1110.	881.	461.	3985.
1953	147.	21.	0.	0.	0.	46.	162.	416.	608.	1110.	814.	386.	3709.
1954	122.	17.	0.	0.	0.	40.	146.	416.	646.	421.	248.	128.	2185.
1955	38.	5.	0.	0.	0.	16.	58.	218.	284.	306.	236.	123.	1283.
1956	36.	5.	0.	0.	0.	27.	122.	352.	626.	888.	626.	241.	2923.
1957	74.	10.	0.	0.	0.	27.	105.	341.	666.	1039.	844.	426.	3532.
1958	135.	20.	0.	0.	0.	46.	162.	416.	740.	851.	574.	315.	3258.
1959	98.	14.	0.	0.	0.	29.	112.	322.	438.	623.	395.	217.	2248.
1960	69.	11.	0.	0.	0.	30.	135.	380.	595.	673.	338.	182.	2413.
1961	55.	8.	0.	0.	0.	20.	72.	202.	204.	306.	227.	120.	1213.
1962	41.	6.	0.	0.	0.	28.	114.	359.	637.	956.	719.	347.	3207.
1963	109.	16.	0.	0.	0.	35.	125.	361.	580.	782.	451.	246.	2705.
1964	77.	11.	0.	0.	0.	27.	100.	332.	704.	1056.	823.	406.	3536.
1965	128.	18.	0.	0.	0.	42.	162.	416.	740.	1110.	902.	509.	4026.
1966	162.	23.	0.	0.	0.	46.	162.	416.	740.	703.	372.	204.	2828.
1967	64.	9.	0.	0.	0.	31.	124.	376.	672.	1008.	819.	406.	3511.
1968	129.	20.	0.	0.	0.	46.	162.	416.	740.	1110.	834.	460.	3917.
1969	147.	23.	0.	0.	0.	46.	162.	416.	740.	929.	667.	298.	3428.
1970	94.	14.	0.	0.	0.	35.	130.	380.	740.	1110.	814.	387.	3704.
1971	124.	19.	0.	0.	0.	46.	162.	416.	740.	1110.	873.	431.	3921.
1972	139.	21.	0.	0.	0.	46.	162.	416.	740.	1110.	808.	381.	3823.
1973	121.	18.	0.	0.	0.	45.	162.	416.	740.	1024.	818.	402.	3745.
1974	142.	22.	0.	0.	0.	46.	162.	416.	740.	1110.	818.	395.	3850.
1975	125.	18.	0.	0.	0.	42.	150.	416.	740.	1110.	902.	460.	3962.
1976	147.	21.	0.	0.	0.	46.	162.	416.	740.	829.	553.	308.	3222.
1977	96.	14.	0.	0.	0.	29.	105.	293.	204.	306.	248.	136.	1431.
1978	42.	6.	0.	0.	0.	14.	78.	296.	537.	958.	711.	345.	2987.
1979	112.	16.	0.	0.	0.	35.	130.	378.	604.	519.	248.	140.	2182.
1980	42.	6.	0.	0.	0.	19.	81.	359.	639.	958.	745.	361.	3210.
1981	115.	17.	0.	0.	0.	38.	139.	416.	740.	1110.	789.	374.	3737.
1982	118.	18.	0.	0.	0.	40.	149.	416.	740.	1110.	902.	462.	3954.
1983	162.	23.	0.	0.	0.	46.	162.	416.	740.	1110.	902.	509.	4069.
1984	162.	23.	0.	0.	0.	46.	162.	416.	740.	1110.	902.	504.	4065.
1985	162.	23.	0.	0.	0.	46.	162.	416.	740.	945.	682.	324.	3500.
1986	108.	17.	0.	0.	0.	46.	162.	416.	740.	1110.	902.	463.	3963.
1987	156.	23.	0.	0.	0.	46.	162.	416.	740.	805.	524.	314.	3186.
1988	104.	15.	0.	0.	0.	34.	125.	384.	675.	676.	343.	185.	2541.
1989	56.	8.	0.	0.	0.	16.	87.	301.	322.	306.	248.	150.	1494.
1990	50.	8.	0.	0.	0.	21.	86.	269.	204.	306.	248.	150.	1342.
1991	50.	7.	0.	0.	0.	19.	71.	222.	357.	552.	279.	173.	1731.
1992	60.	9.	0.	0.	0.	31.	124.	363.	544.	306.	248.	130.	1814.
1993	39.	5.	0.	0.	0.	12.	71.	299.	632.	948.	770.	390.	3167.
1994	126.	19.	0.	0.	0.	43.	162.	416.	679.	652.	321.	173.	2591.
1995	53.	8.	0.	0.	0.	25.	116.	312.	444.	995.	808.	406.	3166.
1996	131.	20.	0.	0.	0.	46.	162.	416.	740.	1110.	816.	388.	3828.
1997	123.	18.	0.	0.	0.	45.	162.	416.	740.	1110.	810.	393.	3818.
1998	133.	21.	0.	0.	0.	46.	162.	416.	740.	1110.	902.	464.	3994.
1999	155.	23.	0.	0.	0.	46.	162.	416.	740.	1110.	824.	430.	3906.
2000	141.	21.	0.	0.	0.	46.	162.	416.	673.	573.	248.	128.	2409.
2001	42.	6.	0.	0.	0.	19.	89.	291.	514.	306.	248.	128.	1644.
2002	38.	5.	0.	0.	0.	16.	69.	225.	204.	306.	237.	123.	1223.
2003	36.	5.	0.	0.	0.	13.	61.	197.	293.	306.	248.	158.	1317.
2004	54.	8.	0.	0.	0.	19.	90.	284.	278.	306.	248.	164.	1450.
2005	55.	9.	0.	0.	0.	27.	107.	322.	668.	1002.	764.	377.	3329.
2006	121.	17.	0.	0.	0.	39.	146.	416.	740.	961.	678.	327.	3445.
2007	108.	17.	0.	0.	0.	39.	149.	416.	740.	704.	403.	229.	2804.
2008	75.	11.	0.	0.	0.	28.	101.	300.	606.	1045.	816.	395.	3379.
2009	129.	19.	0.	0.	0.	40.	147.	416.	740.	1110.	824.	420.	3843.
2010	136.	20.	0.	0.	0.	42.	147.	416.	670.	1110.	817.	396.	3753.
2011	127.	18.	0.	0.	0.	42.	162.	416.	740.	1110.	902.	463.	3980.
2012	152.	23.	0.	0.	0.	46.	162.	416.	563.	306.	248.	145.	2062.
MEAN	103.	15.	0.	0.	0.	35.	132.	372.	629.	853.	629.	319.	3086.

ENLARGED WOODRUFF NARROWS END OF MONTH ELEVATION FEET

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	ANN
1941	6424.5	6424.8	6425.8	6426.7	6427.1	6432.0	6438.7	6429.6	6424.0	6418.1	6417.7	6417.6	6425.5
1942	6423.8	6428.4	6431.9	6434.4	6436.7	6441.0	6448.6	6448.6	6448.6	6442.5	6434.2	6433.5	6437.7
1943	6433.0	6433.2	6434.2	6435.3	6437.2	6443.4	6454.5	6454.5	6452.9	6449.2	6442.7	6442.2	6442.7
1944	6442.2	6443.0	6444.0	6445.1	6446.2	6447.2	6454.5	6454.5	6454.5	6454.0	6447.7	6447.2	6448.3
1945	6447.0	6447.3	6447.8	6448.9	6450.1	6453.4	6454.5	6454.5	6452.5	6451.1	6448.5	6449.1	6450.4
1946	6450.5	6452.9	6454.5	6454.5	6454.5	6454.5	6454.5	6454.5	6445.5	6438.0	6427.9	6427.1	6447.4
1947	6427.5	6430.9	6434.7	6437.1	6439.3	6452.0	6452.3	6452.3	6452.3	6451.2	6446.1	6446.2	6443.5
1948	6447.2	6449.2	6451.3	6453.4	6454.5	6454.5	6454.5	6454.5	6447.6	6440.5	6431.5	6430.8	6447.5
1949	6430.3	6431.0	6433.6	6436.0	6437.8	6441.1	6454.0	6454.0	6454.0	6451.9	6445.4	6445.0	6442.8
1950	6445.5	6446.7	6448.2	6449.5	6451.1	6454.5	6454.5	6454.5	6454.5	6454.5	6449.6	6449.9	6451.1
1951	6451.0	6452.9	6454.5	6454.5	6454.5	6454.5	6454.5	6454.5	6454.5	6453.3	6450.5	6451.0	6453.4
1952	6454.0	6454.5	6454.5	6454.5	6454.5	6454.5	6454.5	6454.5	6454.5	6454.0	6450.8	6451.3	6453.8
1953	6452.0	6452.8	6454.3	6454.5	6454.5	6454.5	6454.5	6446.8	6454.5	6450.1	6443.6	6443.1	6451.3
1954	6442.8	6443.2	6445.0	6446.8	6448.4	6450.6	6454.5	6448.8	6424.2	6418.1	6416.8	6415.6	6437.9
1955	6414.5	6414.1	6416.3	6419.6	6421.9	6423.1	6431.8	6424.5	6418.1	6417.3	6416.1	6415.0	6419.4
1956	6414.0	6416.6	6426.0	6431.1	6434.5	6443.3	6447.8	6447.8	6445.9	6439.1	6429.6	6428.7	6433.7
1957	6428.1	6428.8	6430.8	6432.3	6434.2	6437.3	6446.7	6449.9	6453.0	6453.0	6447.4	6447.2	6440.7
1958	6447.8	6449.6	6451.3	6452.7	6454.3	6454.5	6454.5	6454.5	6444.3	6436.7	6435.9	6435.3	6447.6
1959	6434.9	6434.5	6434.5	6435.3	6436.4	6439.1	6444.8	6434.8	6433.4	6427.5	6427.0	6427.0	6434.1
1960	6429.9	6433.2	6434.4	6435.7	6437.1	6447.3	6452.2	6446.1	6435.4	6424.0	6423.0	6422.0	6435.0
1961	6421.6	6421.9	6423.7	6425.5	6426.9	6427.8	6430.2	6418.1	6418.1	6416.7	6415.8	6416.9	6421.9
1962	6417.2	6418.4	6422.2	6425.2	6435.1	6439.5	6448.4	6448.4	6448.4	6445.8	6438.6	6438.1	6435.4
1963	6438.1	6438.9	6440.3	6440.7	6443.9	6444.9	6448.7	6445.3	6439.7	6430.8	6430.1	6429.5	6439.2
1964	6429.3	6430.4	6432.1	6433.6	6434.7	6436.0	6445.9	6453.4	6453.4	6452.2	6445.9	6445.4	6441.0
1965	6445.2	6445.3	6447.7	6450.5	6452.5	6454.5	6454.5	6454.5	6454.5	6454.5	6454.5	6454.5	6451.9
1966	6454.5	6454.5	6454.5	6454.5	6454.5	6454.5	6454.5	6454.5	6436.5	6426.2	6425.5	6425.3	6445.8
1967	6425.9	6428.6	6432.8	6435.9	6438.2	6444.2	6450.2	6451.4	6451.4	6451.4	6445.9	6445.8	6441.8
1968	6448.3	6450.2	6451.9	6453.4	6454.5	6454.5	6454.5	6454.5	6454.5	6452.8	6450.3	6451.9	6452.6
1969	6454.5	6454.5	6454.5	6454.5	6454.5	6454.5	6454.5	6454.5	6447.4	6442.2	6434.5	6434.3	6449.5
1970	6436.0	6437.7	6439.7	6441.8	6444.0	6445.9	6452.4	6454.5	6454.5	6450.1	6443.8	6444.3	6445.4
1971	6446.6	6448.9	6452.2	6454.5	6454.5	6454.5	6454.5	6454.5	6454.5	6453.8	6447.8	6448.4	6452.1
1972	6450.9	6453.9	6454.5	6454.5	6454.5	6454.5	6454.5	6454.5	6454.5	6449.7	6443.0	6442.8	6451.8
1973	6445.2	6447.7	6449.7	6451.8	6453.8	6454.5	6454.5	6454.5	6452.7	6451.0	6445.6	6448.9	6450.8
1974	6452.9	6454.5	6454.5	6454.5	6454.5	6454.5	6454.5	6454.5	6454.5	6451.2	6445.0	6444.9	6452.5
1975	6445.2	6446.1	6447.7	6449.4	6450.7	6452.8	6454.5	6454.5	6454.5	6454.5	6450.4	6451.1	6450.9
1976	6452.6	6454.5	6454.5	6454.5	6454.5	6454.5	6454.5	6454.5	6442.8	6435.7	6435.3	6435.0	6448.6
1977	6435.1	6435.4	6435.6	6435.9	6436.4	6437.1	6439.7	6418.1	6418.1	6418.1	6417.7	6417.2	6428.7
1978	6417.6	6417.5	6417.6	6418.6	6419.5	6430.0	6440.2	6441.3	6448.5	6445.5	6438.4	6439.0	6431.1
1979	6439.6	6440.1	6441.1	6442.2	6443.4	6445.9	6451.4	6446.6	6429.2	6418.1	6418.1	6417.2	6436.1
1980	6417.5	6418.5	6419.7	6422.9	6425.8	6430.9	6448.5	6448.5	6448.5	6447.0	6440.0	6439.9	6434.0
1981	6440.6	6442.2	6443.9	6445.4	6446.9	6448.4	6454.5	6454.5	6454.5	6448.9	6441.9	6441.7	6446.9
1982	6443.6	6444.0	6445.3	6446.7	6448.3	6452.7	6454.5	6454.5	6454.5	6454.5	6451.4	6454.5	6450.4
1983	6454.5	6454.5	6454.5	6454.5	6454.5	6454.5	6454.5	6454.5	6454.5	6454.5	6454.5	6454.5	6454.5
1984	6454.5	6454.5	6454.5	6454.5	6454.5	6454.5	6454.5	6454.5	6454.5	6454.5	6454.3	6454.5	6454.5
1985	6454.5	6454.5	6454.5	6454.5	6454.5	6454.5	6454.5	6454.5	6448.0	6443.5	6436.7	6437.9	6450.2
1986	6441.2	6444.4	6447.6	6450.4	6454.5	6454.5	6454.5	6454.5	6454.5	6454.5	6451.7	6453.6	6451.3
1987	6454.5	6454.5	6454.5	6454.5	6454.5	6454.5	6454.5	6454.5	6441.2	6434.3	6435.9	6437.0	6448.7
1988	6437.7	6439.1	6439.9	6440.6	6441.2	6444.5	6452.7	6452.3	6435.5	6424.3	6423.3	6422.4	6437.8
1989	6422.0	6421.7	6421.5	6421.3	6421.6	6432.4	6441.1	6427.4	6418.1	6418.1	6419.2	6420.1	6423.7
1990	6421.0	6422.9	6425.0	6426.8	6428.4	6432.3	6437.1	6418.1	6418.1	6418.1	6419.2	6420.0	6423.9
1991	6420.7	6422.2	6423.4	6425.0	6426.1	6427.6	6432.2	6430.1	6430.7	6420.0	6421.9	6423.6	6425.3
1992	6424.5	6429.8	6432.6	6435.3	6437.7	6444.3	6448.8	6442.0	6418.1	6418.1	6417.0	6416.0	6430.3
1993	6415.7	6416.0	6416.7	6417.0	6417.3	6427.5	6440.8	6448.1	6448.1	6448.1	6444.2	6445.0	6432.0
1994	6447.6	6449.0	6450.5	6452.0	6453.1	6454.5	6454.5	6452.6	6434.6	6422.8	6421.9	6421.0	6442.8
1995	6422.6	6423.0	6426.0	6428.9	6432.4	6440.4	6443.0	6435.2	6449.8	6449.8	6445.8	6446.2	6436.9
1996	6448.4	6450.6	6452.4	6453.7	6454.5	6454.5	6454.5	6454.5	6454.5	6450.5	6444.0	6444.0	6451.3
1997	6444.4	6445.9	6448.6	6451.4	6454.1	6454.5	6454.5	6454.5	6454.5	6449.8	6444.8	6446.8	6450.3
1998	6450.4	6454.5	6454.5	6454.5	6454.5	6454.5	6454.5	6454.5	6454.5	6454.5	6452.3	6453.5	6453.9
1999	6454.5	6454.5	6454.5	6454.5	6454.5	6454.5	6454.5	6454.5	6454.5	6452.5	6447.7	6448.8	6453.3
2000	6450.4	6451.8	6453.9	6454.5	6454.5	6454.5	6454.5	6451.5	6431.5	6418.1	6416.8	6417.1	6442.4
2001	6418.4	6421.7	6423.4	6424.9	6426.6	6432.9	6439.3	6439.2	6418.1	6418.1	6416.8	6415.7	6424.6
2002	6415.0	6414.6	6417.0	6419.8	6422.4	6427.0	6432.6	6418.1	6418.1	6417.4	6416.1	6415.1	6419.4
2003	6414.3	6417.1	6418.8	6418.8	6418.7	6423.9	6429.6	6425.2	6418.1	6418.1	6420.1	6421.4	6420.3
2004	6421.5	6421.8	6423.1	6424.5	6425.6	6433.1	6438.7	6424.0	6418.1	6418.1	6420.8	6421.7	6424.3
2005	6424.4	6428.2	6430.0	6432.4	6434.6	6437.6	6444.8	6450.1	6450.1	6447.8	6442.3	6442.8	6438.7
2006	6443.3	6444.0	6445.1	6446.2	6447.3	6450.1	6454.5	6454.5	6448.5	6443.1	6437.0	6438.0	6446.0
2007	6441.0	6443.8	6445.5	6446.8	6447.7	6452.7	6454.5	6454.5	6436.6	6428.1	6428.2	6429.0	6442.4
2008	6430.6	6431.5	6432.7	6434.0	6435.1	6436.3	6441.0	6446.7	6453.2	6450.7	6445.0	6445.7	6440.2
2009	6446.1	6446.5	6447.0	6447.7	6448.5	6451.1	6454.5	6454.5	6454.5	6452.5	6446.9	6447.5	6449.8
2010	6448.1	6448.7	6449.1	6449.6	6450.4	6451.4	6454.5	6450.6	6454.5	6450.8	6445.1	6445.3	6449.8
2011	6445.7	6446.0	6447.9	6450.3	6452.0	6454.5	6454.5	6454.5	6454.5	6454.5	6452.0	6453.1	6451.6
2012	6454.5	6454.5	6454.5	6454.5	6454.5	6454.5	6454.5	6443.9	6418.1	6418.1	6418.7	6419.9	6441.7
MEAN	6437.8	6439.1	6440.6	6441.9	6443.2	6446.0	6449.6	6447.5	6443.4	6440.0	6436.5	6436.8	6441.9

ENLARGED WOODRUFF NARROWS END OF MONTH SURFACE AREA ACRES

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	ANN
1941	887.	898.	940.	975.	995.	1219.	1580.	1099.	867.	637.	623.	618.	945.
1942	859.	1048.	1217.	1349.	1473.	1670.	2004.	2004.	2004.	1717.	1337.	1299.	1498.
1943	1272.	1284.	1337.	1398.	1502.	1747.	2312.	2312.	2155.	2040.	1725.	1708.	1733.
1944	1710.	1732.	1764.	1802.	1865.	1926.	2312.	2312.	2312.	2258.	1955.	1924.	1989.
1945	1913.	1928.	1958.	2021.	2087.	2201.	2312.	2312.	2112.	2097.	2000.	2036.	2081.
1946	2091.	2150.	2312.	2312.	2312.	2312.	2312.	2312.	1826.	1544.	1027.	993.	1959.
1947	1008.	1163.	1366.	1495.	1617.	2106.	2110.	2110.	2110.	2099.	1861.	1867.	1743.
1948	1925.	2040.	2100.	2204.	2312.	2312.	2312.	2312.	1949.	1655.	1192.	1155.	1956.
1949	1131.	1169.	1304.	1433.	1533.	1675.	2263.	2263.	2263.	2106.	1822.	1795.	1730.
1950	1827.	1894.	1979.	2060.	2098.	2312.	2312.	2312.	2312.	2312.	2062.	2078.	2130.
1951	2097.	2156.	2312.	2312.	2312.	2312.	2312.	2312.	2312.	2196.	2092.	2096.	2235.
1952	2266.	2312.	2312.	2312.	2312.	2312.	2312.	2312.	2312.	2260.	2094.	2100.	2268.
1953	2107.	2139.	2294.	2312.	2312.	2312.	2312.	1900.	2312.	2087.	1753.	1736.	2131.
1954	1726.	1740.	1796.	1898.	1995.	2092.	2312.	2019.	877.	637.	584.	536.	1518.
1955	499.	487.	564.	698.	788.	834.	1211.	887.	637.	605.	559.	512.	690.
1956	485.	576.	949.	1173.	1353.	1742.	1956.	1956.	1850.	1604.	1096.	1061.	1317.
1957	1034.	1065.	1155.	1237.	1335.	1504.	1895.	2080.	2164.	2164.	1936.	1926.	1625.
1958	1961.	2060.	2099.	2134.	2294.	2312.	2312.	2312.	1773.	1472.	1430.	1396.	1963.
1959	1372.	1356.	1353.	1396.	1457.	1605.	1790.	1369.	1297.	1012.	987.	988.	1332.
1960	1110.	1286.	1346.	1416.	1497.	1928.	2109.	1860.	1402.	868.	827.	791.	1370.
1961	774.	785.	858.	927.	987.	1022.	1125.	637.	637.	582.	546.	591.	789.
1962	602.	649.	800.	912.	1385.	1624.	1992.	1992.	1992.	1843.	1576.	1551.	1410.
1963	1551.	1593.	1648.	1661.	1763.	1792.	2008.	1814.	1628.	1156.	1118.	1095.	1569.
1964	1085.	1137.	1226.	1305.	1366.	1435.	1847.	2200.	2200.	2109.	1846.	1821.	1631.
1965	1805.	1813.	1953.	2091.	2116.	2312.	2312.	2312.	2312.	2312.	2312.	2312.	2164.
1966	2312.	2312.	2312.	2312.	2312.	2312.	2312.	2312.	1464.	955.	929.	917.	1897.
1967	945.	1054.	1264.	1431.	1555.	1771.	2088.	2101.	2101.	2101.	1846.	1841.	1675.
1968	1985.	2088.	2106.	2206.	2312.	2312.	2312.	2312.	2312.	2139.	2089.	2105.	2190.
1969	2312.	2312.	2312.	2312.	2312.	2312.	2312.	2312.	1935.	1709.	1353.	1344.	2070.
1970	1434.	1529.	1628.	1696.	1764.	1851.	2111.	2312.	2312.	2087.	1760.	1774.	1855.
1971	1886.	2023.	2109.	2312.	2312.	2312.	2312.	2312.	2312.	2239.	1959.	1992.	2173.
1972	2096.	2254.	2312.	2312.	2312.	2312.	2312.	2312.	2312.	2071.	1732.	1726.	2172.
1973	1807.	1951.	2071.	2105.	2243.	2312.	2312.	2312.	2132.	2096.	1829.	2024.	2099.
1974	2156.	2312.	2312.	2312.	2312.	2312.	2312.	2312.	2312.	2098.	1795.	1792.	2195.
1975	1807.	1861.	1954.	2050.	2093.	2138.	2312.	2312.	2312.	2312.	2090.	2097.	2111.
1976	2120.	2312.	2312.	2312.	2312.	2312.	2312.	2312.	1727.	1419.	1398.	1378.	2019.
1977	1384.	1400.	1413.	1428.	1456.	1493.	1628.	637.	637.	637.	620.	600.	1111.
1978	618.	615.	618.	659.	692.	1114.	1645.	1679.	1996.	1824.	1566.	1597.	1219.
1979	1625.	1642.	1673.	1710.	1747.	1851.	2101.	1888.	1081.	637.	637.	600.	1432.
1980	613.	653.	703.	825.	940.	1160.	1996.	1996.	1996.	1910.	1639.	1636.	1339.
1981	1658.	1707.	1761.	1819.	1904.	1992.	2312.	2312.	2312.	2023.	1700.	1692.	1933.
1982	1752.	1765.	1816.	1895.	1990.	2128.	2312.	2312.	2312.	2312.	2100.	2312.	2084.
1983	2312.	2312.	2312.	2312.	2312.	2312.	2312.	2312.	2312.	2312.	2312.	2312.	2312.
1984	2312.	2312.	2312.	2312.	2312.	2312.	2312.	2312.	2312.	2312.	2291.	2312.	2310.
1985	2312.	2312.	2312.	2312.	2312.	2312.	2312.	2312.	1969.	1748.	1474.	1538.	2102.
1986	1677.	1779.	1946.	2090.	2312.	2312.	2312.	2312.	2312.	2312.	2103.	2225.	2141.
1987	2312.	2312.	2312.	2312.	2312.	2312.	2312.	2312.	1676.	1343.	1429.	1487.	2036.
1988	1526.	1602.	1636.	1659.	1675.	1781.	2133.	2110.	1409.	880.	842.	806.	1505.
1989	792.	780.	773.	764.	776.	1244.	1673.	1006.	637.	637.	683.	719.	874.
1990	753.	825.	905.	979.	1046.	1234.	1494.	637.	637.	637.	681.	714.	878.
1991	743.	800.	845.	906.	951.	1015.	1232.	1117.	1151.	716.	786.	852.	926.
1992	888.	1108.	1254.	1396.	1526.	1773.	2015.	1701.	637.	637.	592.	555.	1173.
1993	543.	555.	581.	593.	604.	1009.	1662.	1976.	1976.	1976.	1771.	1798.	1254.
1994	1945.	2027.	2091.	2107.	2173.	2312.	2312.	2122.	1358.	822.	786.	753.	1734.
1995	813.	831.	949.	1068.	1242.	1651.	1733.	1389.	2073.	2073.	1843.	1866.	1461.
1996	1992.	2092.	2111.	2235.	2312.	2312.	2312.	2312.	2312.	2091.	1763.	1763.	2134.
1997	1776.	1847.	2005.	2100.	2274.	2312.	2312.	2312.	2312.	2077.	1788.	1901.	2085.
1998	2090.	2312.	2312.	2312.	2312.	2312.	2312.	2312.	2312.	2312.	2110.	2213.	2268.
1999	2312.	2312.	2312.	2312.	2312.	2312.	2312.	2312.	2312.	2112.	1955.	2016.	2241.
2000	2090.	2105.	2253.	2312.	2312.	2312.	2312.	2102.	1195.	637.	584.	599.	1734.
2001	650.	778.	845.	903.	974.	1267.	1616.	1608.	637.	637.	584.	541.	920.
2002	513.	502.	594.	707.	806.	991.	1250.	637.	637.	608.	557.	517.	693.
2003	493.	596.	667.	665.	663.	866.	1096.	915.	637.	637.	718.	769.	727.
2004	772.	784.	833.	888.	930.	1281.	1580.	868.	637.	637.	746.	780.	895.
2005	883.	1038.	1116.	1240.	1357.	1524.	1789.	2087.	2087.	1958.	1712.	1726.	1543.
2006	1743.	1764.	1800.	1865.	1931.	2087.	2312.	2312.	2002.	1737.	1488.	1545.	1882.
2007	1669.	1758.	1825.	1898.	1954.	2129.	2312.	2312.	1466.	1034.	1039.	1074.	1706.
2008	1149.	1191.	1259.	1325.	1385.	1449.	1669.	1893.	2178.	2094.	1795.	1836.	1602.
2009	1862.	1886.	1910.	1952.	1998.	2097.	2312.	2312.	2312.	2112.	1907.	1943.	2050.
2010	1976.	2011.	2035.	2065.	2090.	2100.	2312.	2093.	2312.	2094.	1801.	1814.	2058.
2011	1837.	1854.	1965.	2089.	2107.	2312.	2312.	2312.	2312.	2312.	2107.	2171.	2141.
2012	2312.	2312.	2312.	2312.	2312.	2312.	2312.	1761.	637.	637.	660.	709.	1716.
MEAN	1509.	1569.	1639.	1702.	1767.	1891.	2068.	1964.	1777.	1612.	1449.	1462.	1701.

ANNUAL SHORTAGE ACRE-FT AND PERCENT

	LAND AREA 1	
YEAR	ACRE-FEET	PERCENT
1941	18086.	17.56
1942	0.	0.00
1943	0.	0.00
1944	0.	0.00
1945	0.	0.00
1946	3592.	3.49
1947	0.	0.00
1948	0.	0.00
1949	0.	0.00
1950	0.	0.00
1951	0.	0.00
1952	0.	0.00
1953	0.	0.00
1954	19404.	18.84
1955	38828.	37.70
1956	1920.	1.86
1957	0.	0.00
1958	12000.	11.65
1959	12000.	11.65
1960	12000.	11.65
1961	67517.	65.55
1962	0.	0.00
1963	12000.	11.65
1964	0.	0.00
1965	0.	0.00
1966	12000.	11.65
1967	0.	0.00
1968	0.	0.00
1969	0.	0.00
1970	0.	0.00
1971	0.	0.00
1972	0.	0.00
1973	0.	0.00
1974	0.	0.00
1975	0.	0.00
1976	12000.	11.65
1977	57922.	56.24
1978	0.	0.00
1979	14317.	13.90
1980	0.	0.00
1981	0.	0.00
1982	0.	0.00
1983	0.	0.00
1984	0.	0.00
1985	0.	0.00
1986	0.	0.00
1987	12000.	11.65
1988	12000.	11.65
1989	34724.	33.71
1990	40088.	38.92
1991	12000.	11.65
1992	33525.	32.55
1993	0.	0.00
1994	12000.	11.65
1995	0.	0.00
1996	0.	0.00
1997	0.	0.00
1998	0.	0.00
1999	0.	0.00
2000	12389.	12.03
2001	35079.	34.06
2002	63041.	61.20
2003	33425.	32.45
2004	44134.	42.85
2005	0.	0.00
2006	0.	0.00
2007	12000.	11.65
2008	0.	0.00
2009	0.	0.00
2010	0.	0.00
2011	0.	0.00
2012	30308.	29.43
MEAN	9449.	9.17

SUMMARY PAGE

MEAN ANNUAL SURFACE FLOWS

QX(1) =	156718.	QX(2) =	0.	QX(3) =	153685.	QX(4) =	153685.	QX(5) =	93551.	QX(6) =	60134.
QX(7) =	45276.	QX(8) =	105410.	QX(9) =	0.	QX(10) =	0.	QX(11) =	0.	QX(12) =	0.
QX(13) =	0.	QX(14) =	0.	QX(15) =	0.	QX(16) =	0.				

RESERVOIR	INITIAL	END CONTENT	MAXIMUM	MINIMUM	EVAPORATION
ENLARGED WOODRUFF NARROWS	10000.	6112.	57300.	2688.	3086.

LAND AREA	SHORTAGES	AVG	10-YR	5-YR	2-YR	1-YR
WOODRUFF-RANDOLPH AREA	9449.	9.17%	19.42%	36.52%	47.63%	65.55%

ELAPSED TIME: 0: 0: 0.06

Appendix C | Wyoming Mapping Detail

Wyoming Summary

Table 1 summarizes the 1976 classification of the 1976 geometry. It is a query of the 1976 dataset containing 1976 classification field values and the number of each unique classification category.

Table 1

Frequency	Description_1976 of 1976 Geometry	ACRES
223	Irrigated Cropland	64074
31	Non-Irrigated Cropland	5831
250	Other	2278
24	Urban	984
204	Water	1512
460	Wetlands/natural sub-irrigation	21607
2	No code	16
1192	**Total**	**96302**

Table 2 summarizes the 1976 classification of the 2009 geometry. Similar to Idaho, note that the total area using 2009 geometry increased by 1486 acres. This is most likely due to data refinement with the capability of better mapping resources such as higher resolution background imagery and additional supporting irrigation datasets created by other entities. Figure 1 shows an example of the refinement of data; specifically how roads, buildings and water were reclassified. In Figures 1a and 1b, almost all lands shown were classified as irrigation or natural riparian and sub-irrigated areas when clearly the Bear River and several homestead and road infrastructure exists. This was accounted for in 2009 (Figure 1b).

Table 2

Frequency	Description_1976 of 2009 Geometry	ACRES
350	Irrigated Cropland	62181
22	Non-Irrigated Cropland	5277
7	Other	412
2	Urban	249
11	Water	3671
98	Wetlands/natural sub-irrigation	22848
151	No code	3150
490	**Total**	**97788**

Figure 1a

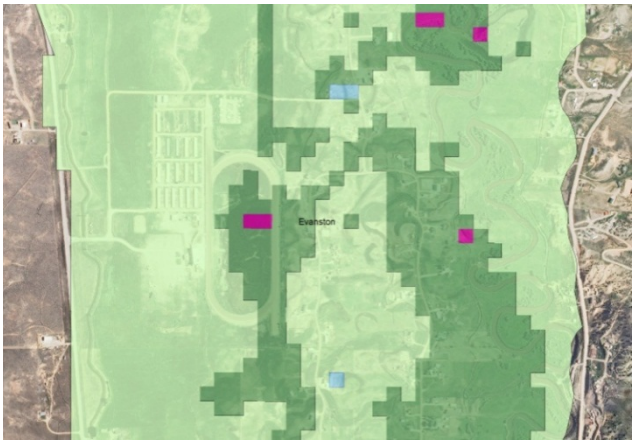


Figure 1b

Figure 2 illustrates how 2009 geometry (black lines) is assigned 1976 classifications (colored pixels). The 1976 data was rasterized to 10 meter pixels. Each 2009 polygon contains a specific number of 1976 classification pixels. Whatever the majority of 1976 classification pixels is in each 2009 polygon determines the 1976 classification for the 2009 geometry. For example, if a 2009 polygon (selected in blue) contains yellow ("urban"), green ("irrigated") and pink ("other") and the majority of the pixels within that polygon are pink, then the polygon is assigned the pink classification category for 1976 i.e., "other. " This type of analysis partially explains how a direct 1976 to 2009 comparison by polygon may not give a true accounting of legitimate change. Identifying polygons where the 1976 classification (as determined using the majority statistical analysis) differs from the 2009 classification (as determined using photo-interpretation) merely provides a starting point to locate areas in which change may have occurred. The final 2009 classification incorporates a thorough water right review to find additional depletion as well as re-examination of the 1976 and 2009 imagery to discern legitimate change from misclassifications.

Figure 2

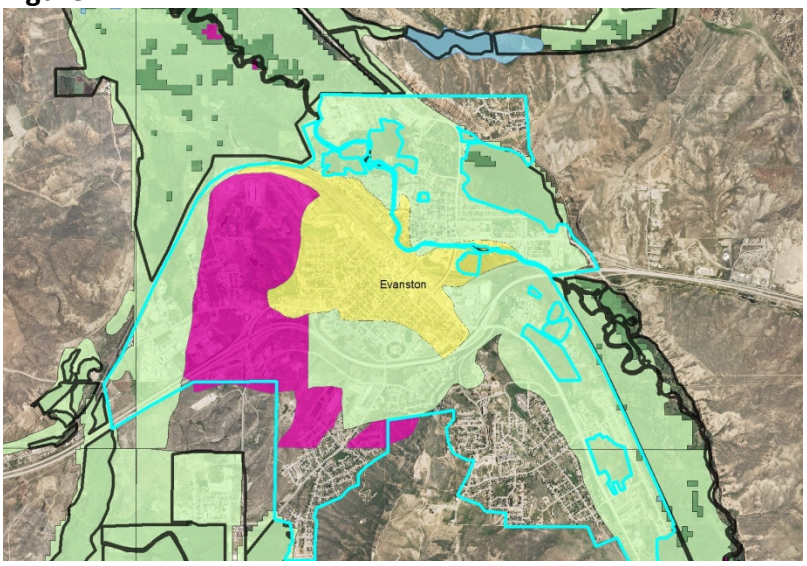


Table 3 summarizes the 2009 classification of the 2009 geometry. It is a query of the 2009 dataset containing 2009 classification field values and the number of each unique classification category.

Table 3

Frequency	Description_2009 of 2009 Geometry	ACRES
281	Irrigated Cropland	69025
35	Non-Irrigated Cropland	6443
1	Other	789
21	Urban	5452
91	Water	4121
212	Wetlands/natural sub-irrigation	11959
641	**Total**	**97789**

The ability to delineate roads, water, etc. using high resolution 2009 NAIP imagery resulted in many acres previously classified as “irrigated” in 1976 to be re-classified. Likewise, better information and methods enhanced the ability to distinguish cropland classifications which resulted in many acres which were previously classified as “irrigated” in 1976 to be re-classified as “non-irrigated”(dry land farms). To reiterate, these types of changes are not legitimate water use changes and are just the result of improved technology.

Table 4 shows reclassification information from 1976 to 2009. Numbers in bold explain where "NI" (non-irrigated), "Other", "Water" or "Urban" changed to "Irrigation" or "RIP" (riparian). There were 730 acres that changed from other classifications in 1976 to irrigation or riparian in 2009. Italicized numbers indicate a reclassification of irrigation or riparian to "NI" (non-irrigated), "Other", "Water" or "Urban" of which the total was 6947 acres.

Table 4

Landtype76 classification	*Landtype 09 classification*	*Total Acres*
IR	*NI*	*1630*
IR	*Other*	*789*
IR	*Urban*	*4439*
IR	RIP	3303
IR	*Water*	*51*
NI	**IR**	**372**
NI	Other	0
NI	Urban	0
NI	Urban	0
NI	**RIP**	**4**
NI	Water	0
Other	**IR**	**354**
Other	NI	56
Other	RIP	0
Other	Water	0
Urban	IR	0
Urban	NI	0
Urban	Other	0
Urban	RIP	0
Urban	Water	12
Water	IR	0
Water	NI	0
Water	Other	0
Water	Urban	0
Wetland	IR	14700
Wetland	*NI*	*21*
Wetland	Other	0
Wetland	*Urban*	*0*
Wetland	*Water*	*17*

Additional Acreages for Irrigated Cropland and Wetland/Naturally Sub-irrigated Pastures and Hay
Based on 2009 Subbasins

Table 5

CENTRAL DIVISION	New acreage	Acreage taken out of production(subtracted)	Net change	Depletion Rate (af)	Depletion (af)
Cokeville	679	0	679	1.04	706.16
Thomas Fork	55	0	55	1.04	57.20
TOTAL	734	0	**734**		**763.36**
UPPER DIVISION					
Cokeville	1005	0	**1004**	1.04	**1044.16**
Evanston	121	-776	**-655**	1.04	**-681.20**
Randolph	0	0	**0**	1.19	**0**
TOTAL	1126	-776	**349**		**362.96**

These acres were derived from the Bear River GIS irrigation mapping project. It depicts true "new" irrigation which was calculated to be 1860 acres for the entire Wyoming Bear River Basin with a subtraction of 776 acres. These 13 new records coincide with the Water Right's Database. The 10 "subtracted" records are those lands that were in production in 1976 but were no longer in production by 2009.

SUPPLEMENTAL SUPPLY IRRIGATION DEPLETION

Wyoming Method for Evaluating Depletion for Supplemental Water Rights

A total of 46 water rights (surface and ground water) were reviewed for supplemental supply. Of these 46, eleven were determined to be expired or were rights providing supplemental water to lands having an original supply with a post-1976 priority date and, therefore, were not included except under their original supply depletion allocation. The Hydrographers/Water Commissioners reviewed available diversion records for the 46 supplemental supply rights and their original supply rights for the years 2003 through 2012. Each supplemental right was also field inspected in 2013.

Generally, to verify the diversion-record days of use for each supplemental right, the Hydrographers/Water Commissioners relied on their own personal knowledge of the rights. For some water rights, they also conducted interviews with the appropriators. An average number of annual days each supplemental right was in use, over a ten year period, was used in each final depletion calculation, ranging from 1.0 to 10.79 days, and averaging 4.82 days. (The 101-day outlier was excluded from the average, as were the zeroes, but included in its own depletion calculation.)

For water rights that were using only their supplemental source, the days were taken from the average of those using both original and supplemental sources, 4.82 days, essentially crediting from their sum the original supplies already accounted under full supply procedures.

With the information described above collected, personnel in Cheyenne relied on information and methodologies used in *Field Verification of Empirical Methods for Estimating Depletion*, by Robert Hill, et al, 1989. Penman-Monteith reference ET calculated values from the Randolph and Montpelier weather stations were used to develop a depletion factor for an August alfalfa crop near Cokeville. This depletion factor was determined to be 0.017 acre-feet per acre per day. The method used shows potential ET (where water is not limiting) based on the Penman-Monteith equation as presented in the above referenced Hill report. See the spreadsheet labeled, "Wyoming – Depletion Factor Calculations" for an explanation of this method.

To determine the depletion amount for each right, the supplemental supply days (column A) was multiplied by the acreage amount in column B or the acreage amount in column C multiplied by the depletion factor in column D.

For example, to calculate the depletion amount for:

Permit No. 25316
4.82 (days) x 50.32 (acreage) x 0.017 (depletion factor) = 4.12 acre-feet
Permit No. 34035
3.20 (days) x 14 (acreage) x 0.017 (depletion factor) = 0.76 acre-feet

Permit No.	Priority	Total Permitted Supplemental Supply Acres	Acreage Using Supplemental Supply Only, No Original - Different from Total Permitted (acres)	Facility Name	Applicant	(A) Supplemental Supply (Days)	(B) Acreage Using Supplemental Supply Only, No Original (Acres)	(C) Acreage Using Supplemental Supply After Original Supply Cannot Be Satisfied (Acres)	(D) Depletion Factor AF/acre/day	(E) Depletion Amount (Acre-Feet)
25316	1/26/1976	50.32		Chalk Creek Pipeline	Albert Feuz	4.82	50.32		0.017	4.12
33364	7/11/2002	49.16		Cooper Ditch Corral Creek Diversion	Robert Kirk	4.82	49.16		0.017	4.03
33627	12/22/2000	34.00		Cornia Pipeline	K-H Cornia Investments Ltd.	4.82	34		0.017	2.79
34035	1/28/2008	14.00		Mud Creek Diversion	Erick and Jeanne Esterholdt	3.20		14	0.017	0.76
34073	6/6/2008	6.10		Icebox Stream No. 1 Ditch	Dan Failoni, Failoni Land and Livestock	4.82	6.1		0.017	0.50
34074	6/6/2008	12.00		Icebox Stream No. 2 Ditch	Dan Failoni, Failoni Land and Livestock	4.82	12		0.017	0.98
34075	6/6/2008	5.80		Icebox Stream No. 3 Ditch	Dan Failoni, Failoni Land and Livestock	4.82	5.8		0.017	0.48
34396	2/12/2010	20.00		Thornock Pump and Pivot	Jason and Tracy Thornock	4.82	20		0.017	1.64
34447	11/30/2000	650.00	255	Alonzo F. Sights Ditch - Bear River through Old Channel Diversion	The Reed Co., Nate Ranches Co., Jon and Vicki Child, Office of state lnads and Investments, Dayton Ranches	6.90		255	0.017	29.91
6976E	9/11/1987	27.00	11.5	Putnam Enl. West Ditch	Putnam Ranch	4.82	11.5		0.017	0.94
6999E	1/24/1991	32.90		First Enl. Sulphur Springs Pipeline - Rock Creek Diversion	Failoni Land and Livestock	4.82	32.9		0.017	2.70
7658E	11/30/2000	99.60		Groo-Burne Enl. Of the Alonzo Sights Ditch	Nate Ranches Company	1.00		99.6	0.017	1.69
7680E	12/22/2010	52.00	7	Buckley Enl. of the Covey Canal	James Buckley	4.53		7	0.017	0.54
UW 42138	2/6/1977	251.08	132	Cornia No. 3 Well	Leo Peter & Joy Cornia, Richard L. & Lynette Cornia, Neil R. & Sharon R. Cornia	4.82	132		0.017	10.82
UW 97747	8/23/1993	128.00		Roberts Land and Livestock #4 Well	Ronald J. Roberts	4.82	128		0.017	10.49
UW 98694	2/3/1995	215.17		Roberts No. 1 Well	L.W. Roberts Trust	3.00		215.17	0.017	10.97
UW 101111	4/30/1993	307.37		Enl. Dana No. 1 Well	Erick and Jeanne Esterholdt	4.82	307.37		0.017	25.19
UW 140753	7/16/2001	300.00		BQ Well No. 1	Peterson Ranches, Inc.	4.82	300		0.017	24.58
UW 145683	5/1/2002	77.00		Roberts Water Well No. 2	Roberts Ranch	4.30		77	0.017	5.62
UW 148842	1/6/2003	3.84		Bird No. 3 Well	Michael and Linda Bird	4.82	3.84		0.017	0.31
UW 150994	4/8/2003	128.00	84	Enl. Roberts Land and Livestock #4 Well	Ronald J. Roberts	4.82	84		0.017	6.88
UW 166251	2/3/2005	1.50		Johnson #1 Well	Kelly and Roseanne Johnson	4.82	1.5		0.017	0.12
UW 191651	10/1/2009	219.56		Potato Hallow Well	Jason Thornock and State Board of Land Commissioners	4.82	219.56		0.017	18.00
UW 193097	2/5/1987	106.35		M. Reed No. 1 Well	Marvel L. Reed	10.79		106.35	0.017	19.51
UW 195332	12/22/2010	284.16	97	Thornock Bros. #1 Replacement Well	U.S. Fish and Wildlife Service	4.82	97		0.017	7.95
UW 195794	2/1/2010	206.00	23	Hansen Well No. 5	Kenneth E. Hansen	101.00		23	0.017	39.49
TOTAL		3280.91					1495.05	797.12		231.01
								TOTAL ACREAGE	2292.17	
SUPPLEMENTAL	**SUPPLY**	**RIGHTS**		**IRRIGATION PORTION NOT UTILIZED**						
34861	4/1/2011	163.15		Teichert Spreader Dike Diversion of the Thompson slough	Teichert Bros., LLC & Mary Katherine Thompson Trust	0.00				0.00
7667E	1/26/2010	12.00		Hansen Westside Enl. Of the Wahsatch Irrigating Ditch	Kenneth E. Hansen	0.00				0.00
UW 41237	7/16/1977	552.74		Bartek #1 Well	Peterson Brothers	0.00				0.00
UW 60689	2/8/1982	158.62		Buckley No. 4 Well	Joe and Janet Buckley	0.00				0.00
UW 107739	1/2/1997	35.62		4-E #1 Well	Erick and Jeanne Esterholdt	0.00				0.00
UW 170139	9/8/2005	15.00		Linford #1 Well	A. Martin Linford Jr. and Cody Marie Linford	0.00				0.00
UW 186878	2/1/2008	185.00		Nate Maninfior (One) Well	Greg Nate	0.00				0.00
UW 187280	5/27/2008	86.00		Teichert Brothers No. 1 Well	Teichert Borthers LLC	0.00				0.00
UW 195333	12/22/2010	184.10		Beckwith and Enl. Replacement Well	U.S. Fish and Wildlife Service	0.00				0.00
TOTAL		1392.23								

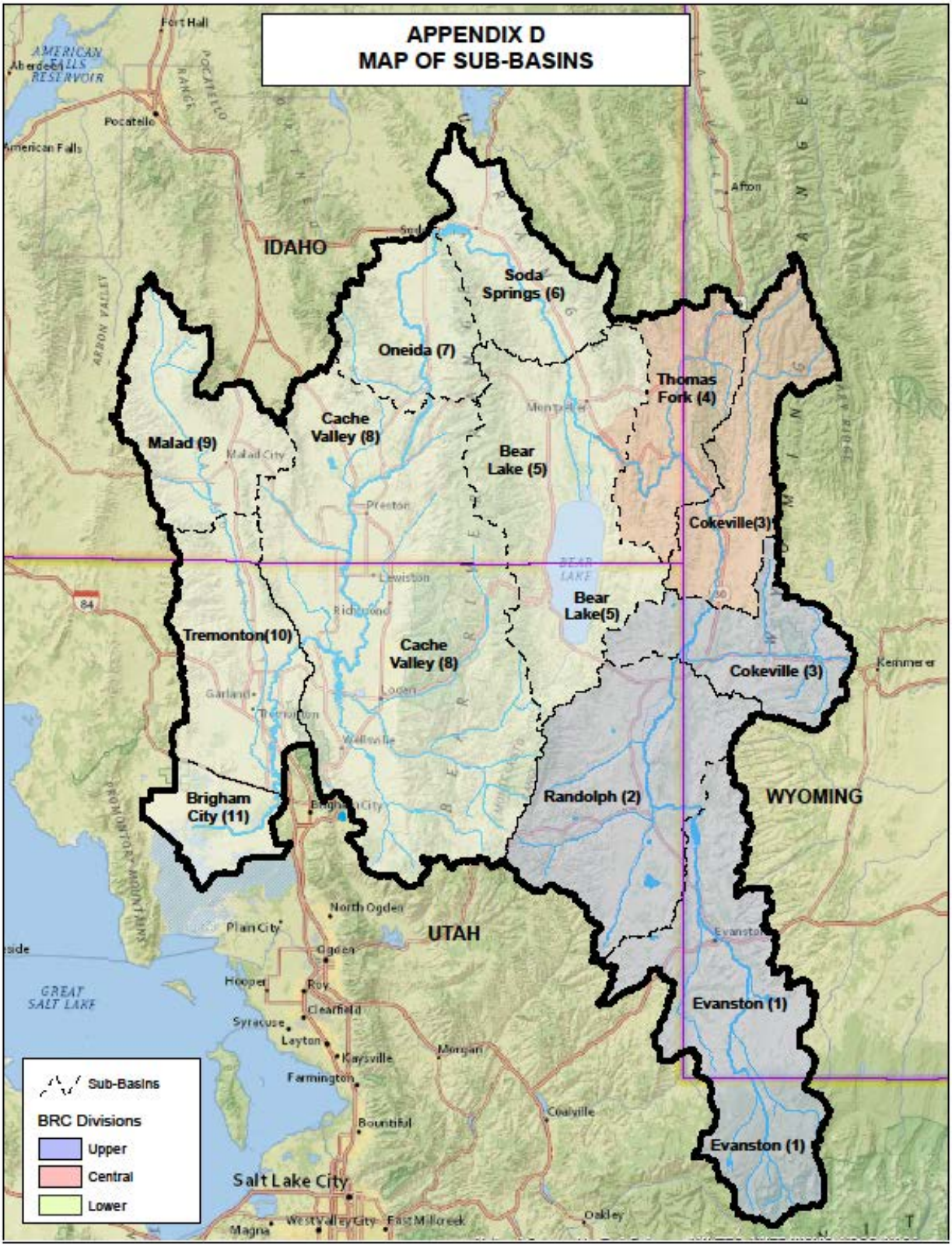
Bear River -- Depletion Factor for Cokeville Area, August, Alfalfa

Depletion Factor = (Etr*Kc)-Peff-SM

Etr - PM with Alfalfa Reference
Kc - Crop coefficient = 1.0 for August Alfalfa
Peff - Effective Precipitation = 80%
SM - Soil moisture = 0 for August
August has 31 days

	Randolph				Depletion		Montpelier				Depletion
	ETr - Daily	Etr-month	Prcp.	Peff	Factor		ETr - Daily	Etr-month	Prcp.	Peff	Factor
1982	0.24	7.51	1.12	0.90	**0.21**	1982	***	***	***	***	***
1983	0.20	6.13	2.37	1.90	**0.14**	1983	0.20	6.26	3.10	2.48	**0.12**
1984	0.22	6.69	1.47	1.18	**0.18**	1984	0.19	5.93	0.95	0.76	**0.17**
1985	0.27	8.40	0.08	0.06	**0.27**	1985	0.26	7.97	0.09	0.07	**0.25**
1986	0.25	7.82	1.11	0.89	**0.22**	1986	0.20	6.08	0.68	0.54	**0.18**
1987	0.22	6.87	0.78	0.62	**0.20**	1987	0.23	7.05	0.43	0.34	**0.22**
				Mean (inches) =	**0.20**					**Mean (inches) =**	**0.19**
				Mean (feet) =	**0.0170**					**Mean (feet) =**	**0.0156**

Appendix D | Sub-Basin Boundary Map


APPENDIX D
MAP OF SUB-BASINS
IDAHO
WYOMING
UTAH
Soda Springs (6)
Oneida (7)
Thomas Fork (4)
Cache Valley (8)
Malad (9)
Bear Lake (5)
Cokeville(3)
Bear Lake(5)
Tremonton(10)
Cache Valley (8)
Cokeville (3)
Brigham City (11)
Randolph (2)
Evanston (1)
Evanston (1)
Sub-Basins
BRC Divisions
Upper
Central
Lower
Salt Lake City
GREAT SALT LAKE
Fort Hall
Pocatello
American Falls
Afton
Preston
Lewiston
Richmond
Logan
Garland
Tremonton
Brigham City
North Ogden
Plain City
Ogden
Hooper
Roy
Clearfield
Syracuse
Layton
Kaysville
Farmington
Bountiful
Morgan
Coalville
Evanston
Kemmerer
Oakley
Magna
West Valley City
East Millcreek